TM 11-5820-540-35

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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DS, GS, AND DEPOT
MAINTENANCE MANUAL

RADIO SETS AN/GRC-103(V)
1, 2, and 3

This copy is a reprint which includes current pages from Changes 1 through 3.

HEADQUARTERS, DEPARTMENT OF THE ARMY

AUGUST 1969

WARNING

Be careful when working on the 115-volt ac line connections. Serious injury or death may result from contact with these terminals.

DON'T TAKE CHANCES!

EXTREMELY DANGEROUS VOLTAGES EXIST IN THE FOLLOWING UNITS OF RADIO SET AN/GRC–103(V)1:

TRANSMITTER, RADIO 5TR1	800 volts dc
AMPLIFIER-FREQUENCY MULTIPLIER AM–4320/GRC–103(V)	600 volts dc

DANGEROUS RADIO FREQUENCY VOLTAGES EXIST AT THE ANTENNA TERMINALS

Be careful when working around the antenna or the antenna terminals. High voltages exist at these points.

WARNING

Operator and maintenance personnel should be familiar with the requirements of TB SIG 291 before attempting installation or operation of the equipment covered in this manual. Failure to follow requirements of TB SIG 291 could result in injury or DEATH.

TECHNICAL MANUAL
No. 11–5820–540–35

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *21 August 1969*

DS, GS, and Depot Maintenance Manual

RADIO SETS AN/GRC–103(V)1, AN/GRC–103(V)2, AN/GRC–103(V)3

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CHAPTER 1

INTRODUCTION

1-1. Scope

a. This manual contains instructions for direct support, general support, and depot support maintenance for Radio Sets AN/GRC-103(V)1 (band 1), (V)2 (band II), and (V)3 (band III). It includes instructions appropriate to the various maintenance categories for troubleshooting, testing, aligning, and repairing the equipment, and replacing maintenance parts. Detailed theory of operation of the equipment is contained in chapter 2. Direct support, general support, and depot maintenance instructions are contained in chapters 3, 4, and 5 respectively.

b. The complete manual for this equipment includes TM 11-5820-540-12.

1-2. Maintenance Forms and Records

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750.

1-3. Reporting of Errors

The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to Commander, US Army Electronics Command, ATTN: AMSEL-MA-CR, Fort Monmouth NJ 07703.

CHAPTER 2

FUNCTIONING OF EQUIPMENT

Section I. TRANSMITTER, RADIO T-983(P)/GRC-103(V)

NOTE

A functional block diagram analysis of the complete radio set is given in paragraph 6-2 of TM 11-5820-540-12.

2-1. Block Diagram Analysis of Transmitter, Radio T-983(P)/GRC-103(V) (fig. 2-1)

a. Transmitter, Radio T-983(P)/GRC-103 (V) (transmitter fixed head) accepts baseband signals in the frequency range of 200 Hz to 1 MHz at the VIDEO connector and order wire signals from 200 Hz to 4 kHz at the OW connector; both connectors are located at the rear of Case, Transmitter CY-4637/GRC-103(V) (transmitter case). The two input signals are combined and amplified in amplifier-monitor 5TR1A5, and then used to modulate the basic signal frequency generated in electrical frequency synthesizer 5TR1A2 (synthesizer). The level of the incoming video signal can be adjusted by the INPUT control on the front of the transmitter fixed head before it is fed into the amplifier-monitor. The amplifier-monitor attenuates the signal as required to insure that transmitter deviation remains constant as frequency multiplication factors are changed during transmitter tuning. This is accomplished through relays controlled by signals from Amplifier-Frequency Multiplier AM-4320/GRC-103(V) (transmitter rf head) which are initiated in control-indicator 6A3.

b. The crystal-controlled synthesizer generates the basic signal frequency in the range of 47.5 to 72.5 MHz in steps of 125.0 kHz or 83.333 kHz, depending on the frequency multiplication factor used (4 or 6 respectively). The synthesizer frequency is selected by the control-indicator and becomes, after appropriate multiplication, the final transmit frequency in the range of 220 to 405 MHz. The combined baseband and order wire signal from amplifier-monitor 5TR1A5 modulates the basic signal frequency to produce an fm signal in the range of 47.5 to 72.5 MHz at the output of the synthesizer. The output of the synthesizer is fed to amplifier-frequency multiplier 5TR1A4 where it is doubled in frequency and amplified to produce a 3-watt (nominal) output signal. The resulting 95 to 145 MHz rf signal is fed to the frequency multiplication circuits in the transmitter rf head.

c. A sample of the rf power at the output of the transmitter rf head is rectified and supplied to alarm control 5TR1A3 which provides a warning when the rf signal power falls about 8 db below the nominal output power.

d. Power for all units in the transmitter fixed and rf heads is obtained from power supply 5TR1PS1 located in the transmitter fixed head. The power supply provides unregulated dc power at 26 volts for operating alarms and control circuits; regulated dc power at 12 volts and 28 volts to operate the general electronic circuits; 630 volts dc unregulated to operate radio frequency amplifier 6AR1 tubes; two supplies of 6.8 volts dc unregulated for the heaters of the radio frequency amplifier tubes; a 400-Hz, 128 volt, square wave output to operate centrifugal fan 5A2B1 in the transmitter case; and a 400-Hz 26-volt square wave output for operation of alarm control 5TR1A3. The power supply includes two constant-current regulators for the cathodes of the rf amplifier tubes. It operates from a 115-volt, ac, 47- to 420-Hz source.

e. Metering facilities are provided in the transmitter for the 28-volt, 12-volt, and 630-volt supplies; for the output levels of synthesizer 5TR1A2 (OSC), amplifier-frequency multiplier 5TR1A4 (DOUBLER), frequency-multiplier assembly 6A2 (MULT), driver stage (DRIVER), and output (PWR OUT) of radio frequency amplifier 6AR1; for the reflected rf power (REFL PWR); and for the frequency deviation in the three modes of operation (12 CH PCM, 24 CH PCM, and FDCM). Alarm circuits (audible and visible) are provided to indicate an out-of-lock con-

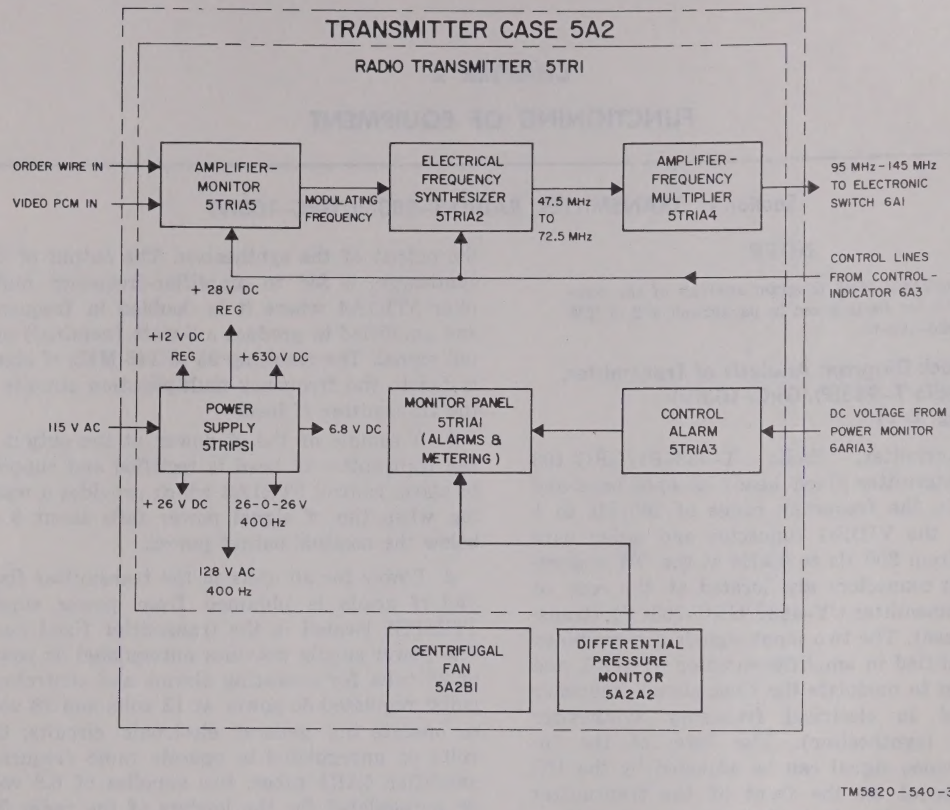


Figure 2-1. Transmitter, Radio T-983(P)/GRC-103(V), block diagram.

dition of the afc loop used to control the output frequency of the synthesizer (SYNC), low rf output power (LOW POWER), and failure of the air cooling system (OVERHEAT).

2-2. Amplifier-Monitor 5TR1A5

a. General. Amplifier-monitor 5TR1A5 consists of two separate printed circuit boards, video amplifier 5TR1A5AR1 and video monitor 5TR1A5A1, both of which are mounted in the same case. This signal path is shown in figure 2-2 and the overall circuit diagram is shown in figure 2-2).

b. Block Diagram Analysis (fig. 3-2).

(1) *Video amplifier 5TR1A5AR1.* The video input signal (12-channel pcm, 24-channel pcm, or fdm) from the INPUT level control is fed through a low-pass filter having a gaussianshaped response of 3 db down at 567 kHz and 11 db down at 960 kHz. The video output of the filter is added in a linear manner to the order wire signal through a simple resistive network. The pcm video is not modulated with the order wire signal; the peak voltage and the baseline vary simultaneously at the order wire signal frequency. The combined video and order wire signal is then fed to a three-stage video amplifier which has approximately 7 db gain. The output of the last stage of this amplifier, an emitter-follower, is fed through a series of relay-controlled attenuators to modulator-oscillator 5TR1A2A2 in the synthesizer. The relays switch the three pi-type attenuators into the circuit, as required to adjust the output signal in the proper proportion to the final signal multiplication factor; this is done to insure a constant transmitter deviation for the various multiplication factors. The attenuation, compared to the multiplication factor, is shown below.

Multiplication factor	Attenuation
4	0 db Band I
6	3.5 db Band I
8	6.0 db Band II
12	9.5 db Band II and III
16	12.0 db Band III

(2) *Video monitor 5TR1A5A1.* A portion of the video amplifier output is fed to video monitor 5TR1A5A1 for metering purposes. The input signal from video amplifier 5TR1A5AR1 is fed to two-stage amplifier Q1–Q2 of video monitor 5TR1A5A1. The output from the second amplifier stage is fed to a temperature-compensated rectifier circuit where it is peak detected and fed to three calibrated metering points, which have adjustable resistors for calibrating the meter indications at midscale for 24-channel or 12-channel pcm, or fdm signal levels. The meter common point is connected to ground.

c. Circuit Diagram Analysis (fig. 6–1).

(1) *Video amplifier 5TR1A5AR1.* The video or fdm signals are coupled through R1 to low-pass filter FL1. The filter attenuates the signals in a gaussian-shaped response (3 db down at 567 kHz and 11 db down at 960 kHz). This frequency limiting is required to reduce the transmitter rf bandwidth. The video signal at the output of FL1 is fed through C1 to the base of Q1. Order wire signals are applied to the junction of R2 and R3. R2 provides termination for FL1 and R3 terminates the order wire input. The order wire signal is added to the video signal through R2 and then through C1 to the base of Q1. The combined signal at the Q1 collector is coupled through C3 to the base of Q2, and the amplified signal at the collector of Q2 is fed directly to the base of emitter-follower Q3. Q1, Q2, and Q3 form a three-stage amplifier which provides approximately 7 db gain. The signal at the Q3 emitter is fed through C6 and R26, the gain control, through feedback circuit C4 and R13 to the emitter of Q1. C4 extends the high frequency feedback; R26 adjusts the level of the feedback signal. The signal at the output of C6 is also coupled to video monitor 5TR1A5A1, and through R15 to the input attenuator. The three pi-type attenuators R16–R17–R18 (3.5 db), R19–R20–R21 (9 db) and R22–R23–R24 (9 db) are switched into the circuit by remotely-controlled relays K1, K2, and K3 respectively. The change of multiplication factor takes place with the interchange of transmitter rf heads. A further change within each band occurs as the frequency is changed past the middle of each band; this change is initiated by control line 13 from control-indicator 6A3 in the transmitter rf head. Relay operation is arranged to switch the attenuators into the circuit as the relays are de-energized. This is done to insure that the transmitter cannot be over-modulated in the event of a relay failure. The combined video and order wire signal at the output of the attenuators is fed directly into modulator-oscillator board 5TR1A2–A2 of the synthesizer.

(2) *Video monitor 5TR1A5A1.* The second output of the emitter-follower Q3 of video amplifier 5TR1A5AR1 is coupled through C1 and Q1 to the base of emitter-follower Q2. L1, L2, L3 are parasitic oscillation suppressors. The Q2 emitter output is coupled through C3 to rectifier CR2, CR3. C3 attenuates order wire signals while passing video signals. CR1 provides temperature compensation for the rectifier. R7 and R10 are meter calibrating resistors in series with the 24-channel pcm metering line. Similarly, R8 and R11 are in series with the 12-channel pcm metering, and R9 and, R12 are in series with the fdm metering. The meter common point is the Q1 emitter through voltage divider R4 and R5.

2–3. Electrical Frequency Synthesizer 5TR1A2 or 1RE1A2

a. General. Synthesizer 5TR1A2 or 1RE1A2 consists of a voltage controlled oscillator (vco), whose output is fed through a variable divider (programmed counter) to a comparator circuit, and a fixed, crystal-controlled oscillator, whose output is fed through a fixed divider to the same comparator circuit. The comparator circuit then controls the automatic frequency control voltage which in turn controls the vco frequency. The counter is programmed by the code established within control-indicator 6A3 or 2A2. Thus, the synthesizer output frequency can be selected by control-indicator 6A3 or 2A2 and referenced to a crystal oscillator at each selected frequency. The synthesizer consists of the following nine printed circuit boards and one interconnecting box.

Modulator-oscillator	5TR1A2A2	or	1RE1A2A2
Amplifier-monitor	5TR1A2A3	or	1RE1A2A3
Frequency Divider	5TR1A2A4	or	1RE1A2A4
Digital Electronic Divider-counter	5TR1A2A5	or	1RE1A2A5
Digital Electronic Counter	5TR1A2A6	or	1RE1A2A6
Electrical Synchronizer	5TR1A2A7	or	1RE1A2A7
Signal Data Converter-storer	5TR1A2A8	or	1RE1A2A8
Frequency Divider	5TR1A2A9	or	1RE1A2A9
RF Oscillator	5TR1A2Y1	or	1RE1A2Y1
Interconnecting Box	5TR1A2A1	or	1RE1A2A1

b. Block Diagram Analysis (fig. 6–2). Baseband signals from amplifier-monitor 5TR1A5 are applied through a sensitivity control to the mod-

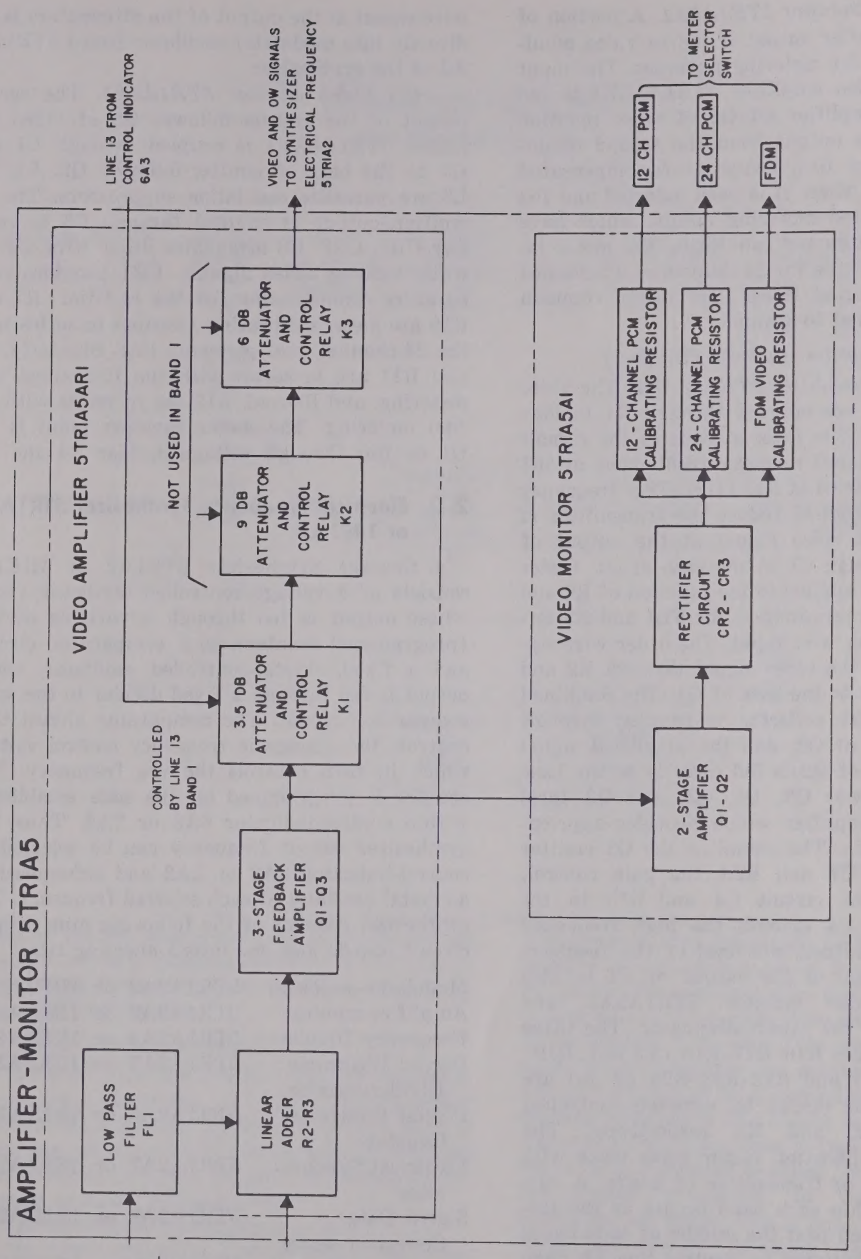


Figure 2-2. Amplifier-monitor 5TR1A5, block diagram.

ulation varactor in modulator-oscillator 5TR1A2-A2. (This modulation facility is not used when the unit is mounted in a receiver). The synthesizer output signal is the selected channel frequency in the range 47.5 to 72.5 MHz. Levels range from about +16 dbm at the lowest frequency to about +12 dbm at the highest frequency.

(1) The voltage controlled oscillator (vco) contained in modulator-oscillator 5TR1A2A2, operates in the frequency range of 47.5 to 72.5 MHz in frequency steps of 125.0 kHz or 83.333 kHz. Two varactors are used to provide precise, instantaneous frequency control. One of the varactors causes frequency modulation of the output signal in response to input baseband signals. The second varactor controls the vco frequency in steps by the automatic frequency control voltage. The output of the oscillator circuit is **stabilized by capacitor C20,** amplified in a wideband amplifier and coupled, through a transformer and a metering detector, directly to the output connector for connection to amplifier-frequency multiplier 5TR1A4. A portion of the output signal is coupled through bandpass filter FL1 to the high speed dividers, contained in frequency divider 5TR1A2A4.

(2) The high-speed dividers are three stages of binary dividers, the first in a chain of dividers, which are required to reduce the frequency of the vco to a range of frequencies which can operate the programmed counters. The frequency at the output of the high-speed dividers is the vco frequency divided by 8, (rf ÷ 8), in the range 5.94 to 9.06 MHz. The output of the high speed dividers is further divided in a second group of three integrated microcircuit binary dividers, contained in digital electronic divider-counter 5TR1A2A5. The output of this second group of binary dividers is 0.742 to 1.13 MHz, (rf ÷ 64). The rf signal at this point is a 4-volt peak-to-peak square wave and is applied through gate A in electrical synchronizer 5TR1A2A7 to the input stages of the programmed counter.

(3) The reference oscillator crystal frequency is 2.0 MHz; the reference oscillator is part of rf oscillator 5TR1A2Y1. This frequency is divided to 1.0 MHz before being applied to a NOR gate, which is used to control the further division of the reference frequency. The 1.0 MHz is further divided by 2 or 3 depending on the absence or presence of control line 13. The output frequency of the reference oscillator, effectively 500 kHz or 333 kHz is then divided by a factor of 2,048 in an 11-stage reference binary divider (frequency divider 5TR1A2A9). The output of the reference divider circuit, a 4-volt peak-to-peak square wave at 244.14 Hz (divide-by-2 operation) or 162.5 Hz (divide-by-3 operation), is fed to the clock pulse generator circuit of electrical synchronizer 5TR1A2A7.

(4) The clock pulse generator circuit produces clock pulses A, B, C and D to control the counters and the error pulse generator. Clock pulse B establishes the start count and end count moments. The end count moment is the reference time to which the full count is compared to produce error pulses. Clock pulse A gates the divided rf signal to the counter through gate A, permitting it to start counting at the start count moment. Clock pulse C is a reset function clearing (set to *zero* state) all counters, including the full count store prior to the start count moment. Clock pulse D is the preset function occurring immediately after clock pulse C. It sets the selected counter stages to *one* prior to the start count moment.

(5) The programmed counter consists of 16 stages of binary dividers of which 10 are programmed by control lines 3 to 12 from control-indicator 6A3. The other six stages are not programmed and are always preset to *one* by clock pulse A (first binary stage) or clock pulse D (binaries 2–6 inclusive). The first binary divider (not programmed) is contained in electrical sychronizer 5TR1A2A7; digital electronic counter 5TR1A2A6 contains nine binary dividers (both programmed and not programmed) and the remaining six programmed dividers are in digital electronic divider-counter 5TR1A2A5. The counter counts the frequency of the incoming signal, indicating a full count when all 16 binary outputs are in the *one* state. This state is sensed by a 16-input gate which generates a full count (–1) pulse to be applied to the error pulse generator. The function of the error pulse generator is to sense the full-count pulse and compare it to the end-count moment, generating a low-count or high-count error pulse if out of synchronization. The low-or high-count error pulses are fed into an error pulse integrator circuit (signal data converter-storer 5TR1A2A8) where they are converted to a dc voltage. This dc voltage is then applied to the vco as an automatic frequency control voltage. This voltage varies from about 12 volts at the 47.5-MHz end of the range to about 9 volts at the 72.5-MHz end of the range. The SYNC alarm circuit of amplifier-monitor 5TR1A2A3 operates the alarm relay if this voltage drifts outside these limits. The alarm relay circuits also operate in the absence of clock pulse D.

2-4. Modulator-Oscillator 5TR1A2A2 or 1RE1A2A2

a. General. This unit is one of the printed circuit board components of synthesizer 1RE1A2 or 5TR1A2. It operates as a voltage controlled oscillator (vco) in the frequency range of 47.5 to 72.5 MHz. The main frequency control, the automatic frequency control (afc) voltage, controls the vco frequency in discrete steps through frequency controlling circuits on other printed circuit boards in the synthesizer. These frequency controlling circuits are in turn controlled by the frequency code in the channel selector, and are referenced to a crystal oscillator. A second frequency controlling voltage, the modulation signal, is used to frequency modulate the output signal when the synthesizer is mounted in a transmitter. This facility is not used when the synthesizer is mounted in a receiver.

b. Block Diagram Analysis (fig. 2-3).

(1) The basic oscillator is a modified Hartley circuit having two varactors acting as capacitors in the parallel resonant circuit. The automatic frequency control voltage from amplifier-monitor 5TR1A2A3, in the range of 2 to 9 volts, controls the capacity of one of the varactors over its required range. The ac modulating voltages from amplifier-monitor 5TR1A5 control the capacity of the second varactor over its required range, the modulating signal level depending upon the type of multiplex system in use. Modulation signals are attenuated within amplifier-monitor 5TR1A5 to maintain transmitter output frequency deviation constant as the multiplication factor is changed. The two varactor capacitors then resonate with a variable coil which is tapped to provide a feedback signal to the base of the oscillator transistor. The afc feedback loop can be open during set-up for test and adjustment purposes.

(2) The oscillator output is amplified in a two-stage amplifier which employs feedback to extend the frequency response over the frequency range. A broadband matching transformer at the amplifier output feeds the signal to bandpass filter 5TR1A2A1A1FL1 on the synthesizer interconnecting board, one portion going directly to the output connector, and the other portion going to the frequency comparison circuits to generate the afc voltage. A variable capacitor at the amplifier adjusts the level of the output signal over the frequency range. A portion of the output signal is rectified to provide metering of the output level. The output frequency, in the range of 47.5 to 72.5 MHz, is in steps of 1230.0 kHz over a portion of the band and in steps of 83.333 kHz over the remainder. The frequency steps are related to multiplication factors of four and six respectively. The level of output level of the signal varies from +16 dbm at the 47.5 MHz end of the frequency range to +12 dbm at the 72.5 MHz end.

c. Circuit Diagram Analysis (fig. 6-3). Q1 is the oscillator transistor. The feedback signal is coupled from the collector through C8 and L2 to L3, and from a tap on L3 through C9 back to the base of Q1. The tuned circuit consists of L3, CR2, and CR3. C4 and C5 are dc blocking capacitors and L1 is an rf block to prevent loss of the oscillator signal on the power supply line. CR2 is the modulation varactor and CR3 is the afc varactor. VARICAP TUNE coil L3 is adjusted during alignment to tune the circuit at each end of the range, with a test voltage applied to the afc varactor.

(1) Afc voltage is fed from pin 5 to J2 through TEST-NORMAL switch S1, R10, and L3 to CR3. TEST-NORMAL switch S1 is a maintenance provision to permit the afc feedback loop to be broken during alignment. Setting this

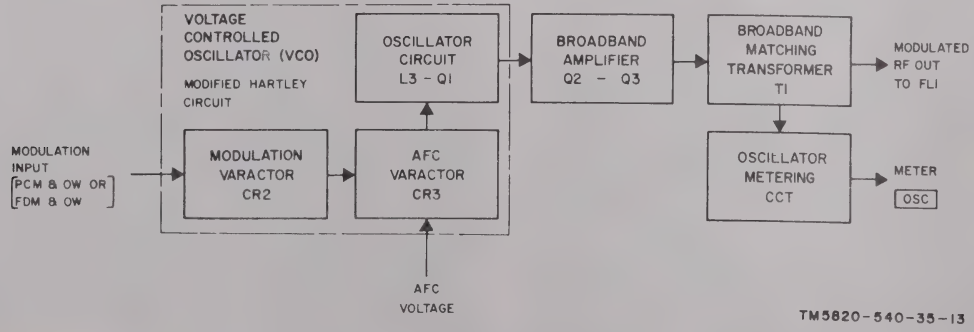


Figure 2-3. Modulator-oscillator 5TR1A2A2 or 1RE1A2A2, block diagram.

switch to the TEST position applies a test voltage to the afc varactor in place of the normal afc voltage. The value of the test voltage can be varied by MANUAL FREQUENCY CONTROL resistor R4.

(2) Modulation is fed from pin 12 of J2 through MODULATION SENSITIVITY resistor R9 and then through C3 to L1 to CR2. Fixed bias for CR2 is established at the junction of R1, and R2, and applied to CR2 through MODULATION COMPENSATION control R6. The capacity of CR2, the modulation varactor, acts as a trimmer capacitor in parallel with CR3 capacity and provides a modulation frequency shift to the oscillator circuit which offests the non-linear reaction of CR3 over the frequency range. As the frequency is increased across the rf range, the voltage on CR3 is increased, decreasing its capacity.

(3) Modulation varactor CR2, having fixed bias, and therefore fixed capacity across the range, assumes a larger percentage of the total tuned circuit capacity at the top end of the range. The capacity variation that results from the modulating signal then provides a fixed capacity swing over the entire range, resulting in a linear modulation sensitivity. The value of the fixed bias on the modulation varactor is adjusted by modulation compensation control R6, to insure correct modulation linearity over the tuning range. The level of the modulating signal applied to the varactor is adjusted by modulation sensitivity control R9.

(4) At the bottom end of the frequency range, the afc varactor CR3 capacity change per volt tends to become more sensitive, resulting in a non-linear frequency shift with afc voltage change. To counteract this effect, diode CR1 is connected between the afc intput voltage and a fixed bias point. Thus, as the afc approaches the 2-volt end of the range, a small amount of voltage is fed through the diode to the afc line trying to pull the vco off frequency. This tendency is sensed in the normal afc loop as a frequency error and results in a more negative afc feedback voltage, resulting in a linear afc control at the low end of the frequency range. RT1 insures that this extra afc voltage is not bled off through CR1.

(5) The oscillator output signal is coupled through coupling capacitor C13 to the base of Q2. From the Q2 collector the signal is directly coupled to the Q3 base, and from the Q3 collector to matching transformer T1. Negative feedback is coupled from the Q3 emitter to the Q2 base to extend the frequency response of the amplifier. A portion of the output signal is fed through C17 to CR4, where it is rectified to produce a dc metering signal.

2–5. RF Dividers, Functional Analysis

The frequency of the signal fed to the programmed counter must be approximately 1 MHz to provide the required frequency resolution with the counter. The signal fed to the programmed counter is derived from modulator-oscillator 5TR1A2A2 output frequency (rf output in the range of 47.5 to 72.5 MHz) by frequency division accomplished in six stages of binary dividers (fig. 6–2). These high speed dividers are mounted, together with a two-stage broad band amplifier, on frequency divider 5TR1A2A4 or 1RE1A2A4. The final three stages of division take place in microcircuit (intergrated) binary dividers, which are mounted on digital electronic divider-counter 5TR1A2A5 or 1RE1A2A5. The output of the divider chain (rf ÷ 64) is a square wave signal at 4 volts peak-to-peak in the frequency range of 0.7 to 1.13 MHz, which is then fed to electrical synthesizer 5TR1A2A7 or 1RE1A2A7 for gating and further division.

2–6. Frequency Divider 5TR1A2A4 or 1RE1A2A4

a. General. Part of the output signal of the modulator-oscillator (rf output) is coupled through splitter filter 5TR1A2A1FL1 or 1RE1A2A1FL1 to the input of frequency divider 5TR1A2A4 or 1RE1A2A4. The filter prevents harmonics generated in the high speed dividers being fed back to amplifier-frequency multiplier 5TR14 or 1RE1A5.

b. Block Diagram Analysis (fig. 2–4). A low level sample of the rf output is first amplified in a two-stage broadband amplifier. The amplifier output is then coupled to the first bistable multivibrator. The negative-going transition of each cycle of input signal causes the multivibrator to switch to one side; the next negative-going transition of input signal causes the multivibrator to switch to the other side. Positive-going transitions cannot initiate the switching action since they are not high enough to override the negative voltage which is holding the transitor off. The multivibrator circuit is temperature-compensated to insure reliable switching over the temperature range of –40 degrees C to +80 de-

grees C. The output of the multivibrator, a square wave at half the frequency of the input signal, is then fed through a single stage buffer amplifier to the next bistable multivibrator circuit. The second and third multivibrator circuits are identical to the first; a single stage buffer amplifier couples the signal between the second and third divider. The output of the third divider circuit is coupled to the output connector through a third single stage buffer amplifier. The output signal (rf÷8) is then fed to the next three dividers of the divider chain which are located on digital electronic divider-counter 5TR1A2A5 or 1RE1A2A5.

c. Circuit Diagram Analysis (fig. 6–4). The input signal at J3 pin 15, in the range of 47.5 to 72.5 MHz, is fed through a 5.6-pf capacitor to the base of Q1, the first stage of the broadband amplifier. The coupling capacitor has a small value to prevent loading of modulator-oscillator 5TR1A2A2 or 1RE1A2A2 output.

(1) Q1 output is coupled to Q2 base through C2. CR1 in the base circuit of Q2 provides base over-voltage protection by limiting the negative voltage swing. The amplifier output is then coupled from a common feed point to the bases of both sides of bistable multivibrator, Q3 and Q4.

(2) The signal at the Q2 collector is fed through C4, R8, L1, and C5 to the Q4 base, and through C4, R13, L2, and C6 to the Q3 base. The negative transition of the signal will tend to lower the base voltage of Q3 and Q4. If Q4 is conducting, the Q3 base will be near ground potential; the negative voltage will not affect it. The Q4 base, however, will drop, causing its collector and the Q3 base to rise, resulting in a reversal of the conducting states of Q3 and Q4. The next negative swing of input signal will then reverse the states again, resulting in an output signal at the Q4 collector at half the frequency of the input signal. L1, L2, C5, and C6 speed up the switching action of the multivibrator.

(3) As the surrounding temperature increases, the current of a transistor increases; therefore, less collector voltage is required to saturate a transistor at a higher temperature. Overdriving the transistors would cause a recovery delay, resulting in unreliable dividing action at high temperatures. To overcome this, the collector volt-

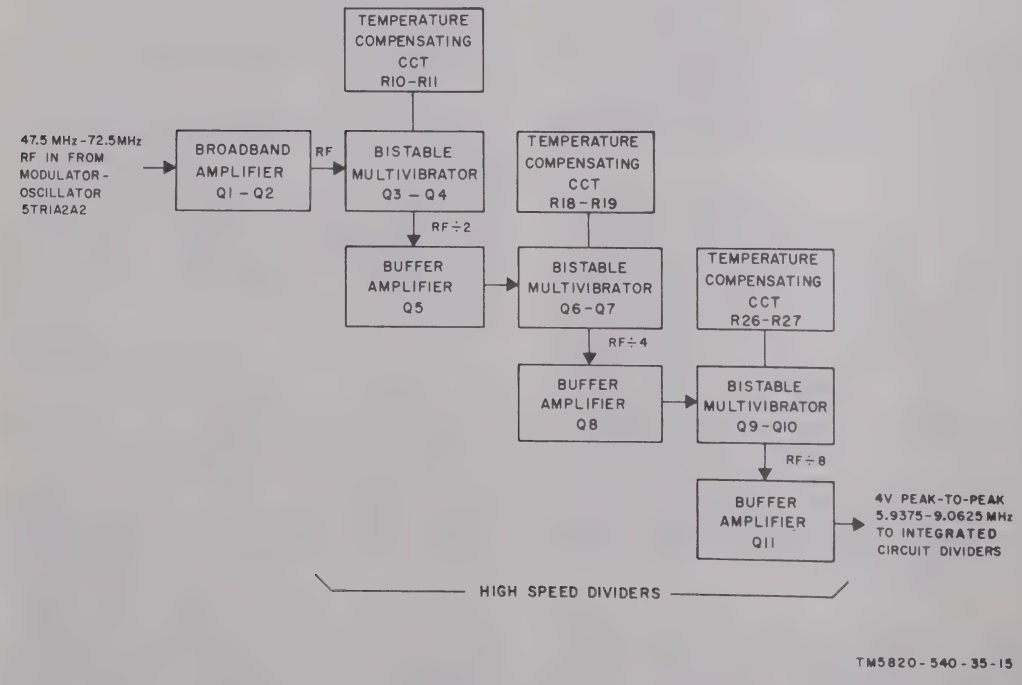


Figure 2–4. Frequency divider 5TR1A2A4 or 1RE1A2A4, block diagram.

age of Q3 and Q4 is fed through thermistor R11, which has a positive temperature coefficient to increase resistance and lower the collector voltage at high temperatures. TEMP COMP control R10 is used to adjust the collector voltage at the temperature extremes to insure reliable counting.

(4) The output from the Q4 collector is fed through C7 to the base of buffer amplifier Q5. Output from Q5 is then fed through C8 to Q6, and Q7, the second divider. This divider operates exactly like the first divider, Q3, and Q4. Similarly, this divider is followed by buffer amplifier Q8, feeding the third divider Q9, and Q10. Q11 is a third buffer amplifier whose output is connected directly to pin 1 on J3.

(5) The output signal, a 4v peak-to-peak square wave in the frequency range of 5.9375 to 9.0625 MHz, is then fed through J3 pin 1 and J5 pin 1 of the interconnecting box to digital electronic divider-counter 5TR1A2A5 or 1RE1A-2A5 for further division (para 2-12).

(6) Test points TP1 (ground) and TP2, TP3, and TP4 permit the monitoring of input signals to each of the high speed dividers.

2-7. RF Oscillator 5TR1A2Y1 or 1RE1A2Y1

a. General. This unit provides the basic crystal-controlled frequency to which each selected synthesizer output frequency is referenced. Clock pulses that control the programmed counters in the synthesizer are derived from this basic crystal-controlled reference frequency by frequency division.

(1) It is necessary for the clock pulses to have a very low repetition rate, in order that the modulator-oscillator 5TR1A2A2 or 1RE1A2A2 rf output can be frequency modulated while still being controlled by the programmed counter. The first division in the clock pulse generating chain takes place within rf oscillator board 5TR1A2Y1 or 1RE1A2Y1.

(2) The output frequency steps of the synthesizer are changed as the overall frequency-multiplication factor is changed in the middle of the band. This is accomplished by changing the division factor (divide-by-2 or divide-by-3 function) within the reference oscillator unit, thus changing the widths of the clock pulses. The divide-by-2 to divide-by-3 change-over is initiated by control line 13 from control-indicator 6A3 or 2A2.

b. Block Diagram Analysis (figs. 2-5 and 2-6). The basic oscillator circuit consists of a three-transistor amplifier with a 2.0-MHz crystal connected in the feedback loop. An adjustable coil, in series with the crystal, provides adjustment of the crystal frequency over a narrow range. A temperature-compensating circuit consisting of a varactor in series with the crystal, and two thermistors, keeps the basic crystal frequency free from drifting over a temperature range of -30° C. to +75° C. The output of the oscillator section is a 2.0-MHz signal at about 4 volts peak-to-peak. This signal is fed to the toggle input of microcircuit binary divider A1; the binary divider outputs, 1-MHz square waves, 4 volts peak-to-peak each, are in antiphase. The two antiphase 1-MHz signals are fed one to each half of dual NOR gate microcircuit A2. One of the two NOR gates inverts the input signal, which is then applied to the toggle input of microcircuit binary divider A3. The other half of NOR gate A2 is held inactive during the divide-by-2 operation.

(1) *Divide-by-2 operation* (fig. 2-5). The 1.0-MHz square wave signal applied to the toggle input of binary A3 is divided by a factor of two. The 500-kHz square wave output is then applied simultaneously to binary A4 (inactive during the divide-by-2 operation) and to one half of NOR gate A5; the second input to NOR gate A5 is inactive during the divide-by-2 operation. The output of NOR gate A5, during the divide by-2 operation, is a 500-kHz square wave, 4 volts peak-to-peak.

(2) *Divide-by-3 operation* (fig. 2-6). The divide-by-3 operation is initiated by control line 13 of control-indicator 6A3 or 2A2 when set for channels 180 and above. For channels 180 and above, control line 13 is supplied with a positive voltage; for channels 179 and lower, control line 13 is grounded. The positive voltage supplied on control line 13 is first amplified in a two-stage amplifier after which it is applied to the input of binary divider A4, activating it. The toggle input to binary A4 is the 500-kHz output of binary divider A3 ((1) above). The output of binary A4 is a 250-kHz signal which is then fed as the other input to the second half of NOR gate A2; the first input being the 1.0 MHz output of the binary A1. The 1.0-MHz signal gated by 500 kHz at the output of NOR gate A2 is then applied to the reset input of binary A3. The output of binary A3 in the divide-by-

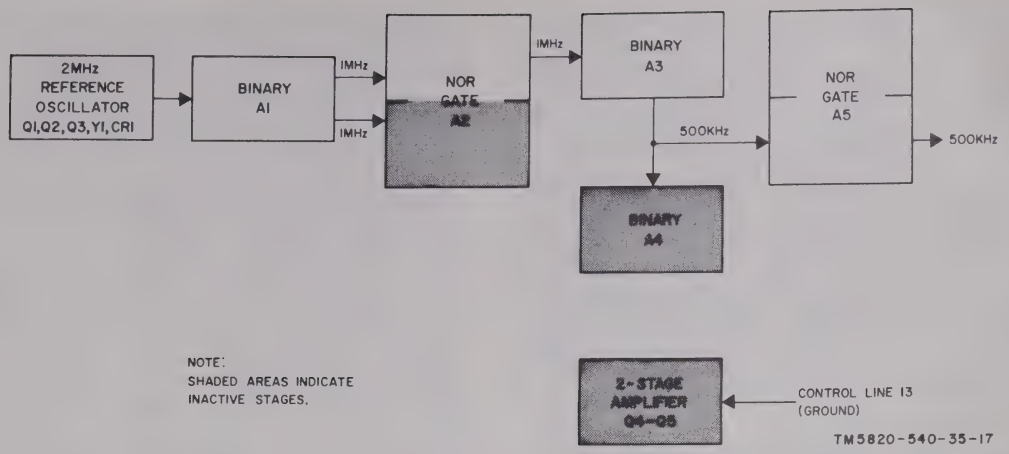


Figure 2–5. Rf oscillator 5TR1A2Y1 or 1RE1A2Y1, divide-by-two function.

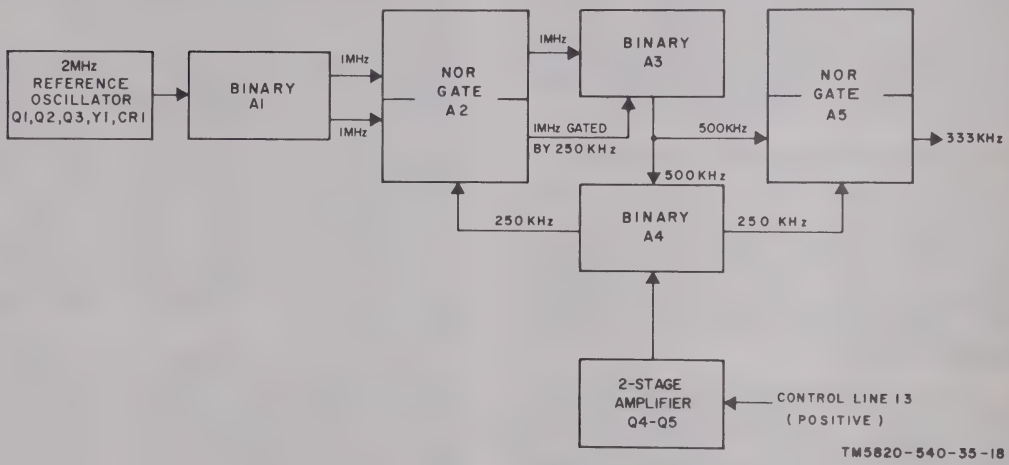


Figure 2–6. Rf oscillator 5TR1A2Y1 or 1RE1A2Y1, divide-by-three function.

3 operation is a 500-kHz signal gated by 1.0 MHz; this signal is fed simultaneously to the toggle input of binary A4 and to one half of dual NOR gate A5. The second output of binary A4 (activated in the divide-by-3 operation) is also fed to NOR gate A5, where it gates the output of binary A3. The output of NOR gate A5 is a positive pulse 2 microseconds long followed by a negative pulse 1 microsecond long, which is effectively a 333-kHz signal.

c. Detailed Circuit Analysis (fig. 6–5). Transistors Q1, Q2 and Q3 form a 2-MHz crystal-controlled oscillator. Feedback is coupled from the Q3 emitter through Y1, R6, L2, L1, CR1, and C1 to the base of Q1. The frequency adjustment control, L1, provides crystal frequency trimming at normal room temperature. Varactor CR1 is used to provide temperature compensation control of the crystal frequency over the operating temperature range of –30°C to +75° C., since the crystal frequency would tend to drift by about 40 Hz at the temperature extremes. The low temperature control, R2, is used to adjust the CR1 bias to provide an exact crystal frequency at –30°C. The high temperature control, R1, is used to adjust the bias applied through thermistor R3 to CR1 at +75°C, to pull the crystal frequency to exactly 2.0 MHz at that temperature.

(1) The oscillator output signal is coupled through C4 to pin 10 (toggle input) of binary divider A1. The outputs at pins 8 and 3 are two antiphase 1.0 MHz square wave signals at 4 volts peak-to-peak. The output at pin 8 of A1 is connected to pin 9 of dual NCR gate A2, and the signal at pin 3 of A1 is connected to pin 3 of A2, one of the inputs of the second NOR gate A2, which is cut off by a negative voltage on pin 5 during the divide-by-2 operation.

(2) The output from pin 10 of A2 is connected to the toggle input, pin 10, of binary divider A3. The output of divider A3 at pin 8 is a 500-kHz square wave signal at 4 volts peak-to-peak, which is then fed simultaneously to pin 3 of dual NOR gate A5 and to the toggle input of binary divider A4, held inactive during the divide-by-2 operation. The input at pin 4 of NOR gate A5 is a positive voltage (output of binary A4, pin 3). The output of NOR gate A5, a 500-MHz square wave from pin 2, is then connected directly to J10, pin 7, and on to the reference dividers on frequency divider 5TR1A2A9 or 1RE1A2A9.

(3) The divide-by-3 function is initiated when line 13 of control-indicator 6A3 or 2A2, connected to J10 pin 8, has a positive voltage on it. This voltage is connected through R18 to the base of Q5. The Q5 collector is connected to the base of Q4. The Q4 collector is connected to set input, pin 7 of binary divider A4, making it active.

(4) The output at pin 8 of binary A4 is fed into pin 5 of NOR gate A2 and is gating the 1.0-MHz square wave. The output at pin 2 of NOR gate A2 is a 0.5 microsecond pulse which is then fed into pin 4 of binary A3 and gates the 1.0 MHz trigger pulse arriving at pin 10 of A3. The result at pin 8 is a 1.0-MHz square wave followed by a 500-kHz square wave, giving the equivalent of a 3-microsecond square wave. This output is applied to pin 10 of binary A4, causing it to change state on the down clock. The binary A4 outputs at pins 3 and 8 are antiphase 333 kHz asymmetrical square waves. The output at pin 8 of A4 is fed into NOR gate A2 pin 5, where it is gated by the 1.0-MHz square wave arriving at pin 5. The output at pin 3 of binary A4 is fed to pin 4 of NOR gate A5, where it gates the 1.0-MHz square wave, followed by the 500-kHz square wave output fed into pin 8 of binary A3. The output at pin 2 of NOR gate A5 is an asymmetrical 333 kHz square wave. Binaries A3 and A4 as described above form a scale-of-three divider. The square wave is positive for 2 microseconds and negative for 1 microsecond. The output from pin 2 of A5 is connected through J10 pin 7 and J9 pin 7 to frequency divider 5TR1A2A9 or 1RE1A2A9.

2–8. Frequency Divider 5TR1A2A9 or 1RE1A2A9

a. General. The frequency divider board provides 11 stages of binary division of the 500-kHz or 333-kHz reference signal from rf oscillator 5TR1A2Y1 or 1RE1A2Y1. The signal at the output of the frequency divider is then applied to electrical synchronizer 5TR1A2A7 or 1RE1A2A7, where it is used to generate the clock pulses required for referencing, gating, set, and reset operation.

b. Block Diagram Analysis (fig. 2–7). The input to the frequency divider is a 500-kHz square wave at 4 volts peak-to-peak over the times-4 portion of the band, and alternate half-cycles of 250 kHz and 500 kHz at 4 volts peak-to-peak over the times-6 portion of the band. The times-6 signal has negative-going transitions spaced 3 microseconds apart, which makes the signal look like 333 kHz to a binary divider. The 11 binaries are connected in cascade to provide a total division of the input signal by 2,048. The output signal is a 244.14-Hz (times-4 portion of the band) or 162.75-Hz (times–6 portion of the band) square wave at 4 volts peak-to-peak. Three test points provide sources for displaying the signal, in three separate groups, as it is divided by each binary.

c. Circuit Diagram Analysis (fig. 6–6). The 500-kHz or 333-kHz signal is fed through C1 to toggle input pin 10 of binary microcircuit divider A1. The binary divider is a bistable multivibrator which will flip from one state to the other when pin 10 input goes negative. The output at pin 8 of binary A1, a 4-volts peak-to-peak square wave at half the frequency of the input signal, is fed directly to the toggle input of binary A2, and so on. The output of binary A11 is coupled through C3 to pin 8 of J9 and on to electrical synchronizer 5TR1A2A7 or 1RE1A2A7. The input signal and the outputs of binaries A1, A2, and A3 are fed in parallel, through R1, R2, R3, and R4 respectively, to A12/TP1, a monitor point which provides a means of displaying the counting cycle on an oscilloscope. R1, R2, R3, and R4 are of different values to provide an oscilloscope presentation in the form of descending steps (fig. 2–7); this facilitates identification of each signal. In a similar manner, the outputs of binary dividers A4 to A7 are conected to

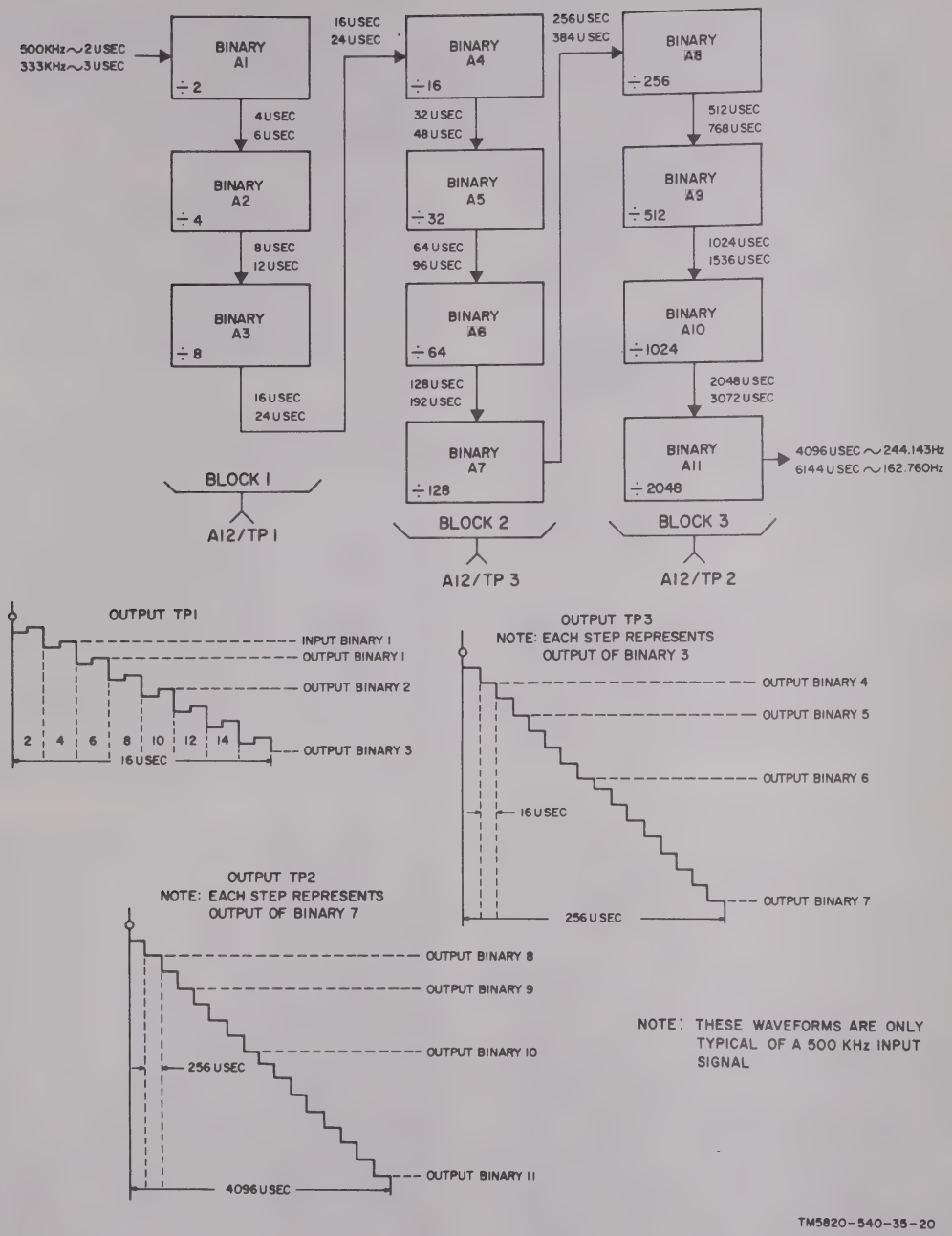


Figure 2-7. Frequency divider 5TR1A2A9 or 1RE1A2A9 block diagram.

A12/TP3 and the outputs of binary dividers A8 to A11 are connected to A12/TP2.

2-9. Electrical Synchronizer 5TR1A2A7 or 1RE1A2A7

a. General. This unit performs two major functions within the synthesizer. The first function is the generation of clock pulses A, B, C, and D. The second is the gating of the full count pulse, generated within the counter, to produce high count or low count error pulses. The error pulses then generate an afc voltage which locks the modulator-oscillator frequency to the selected channel frequency. This unit also gates the modulator-oscillator rf signal applied to the counter circuits; the first binary divider of the counter is also part of the electrical synchronizer board.

(1) The clock pulses are generated by dividing the signal from frequency divider 5TR1A2-A9 or 1RE1A2A9 in a four-stage binary divider and gating the output signals from each divider with the outputs of succeeding dividers.

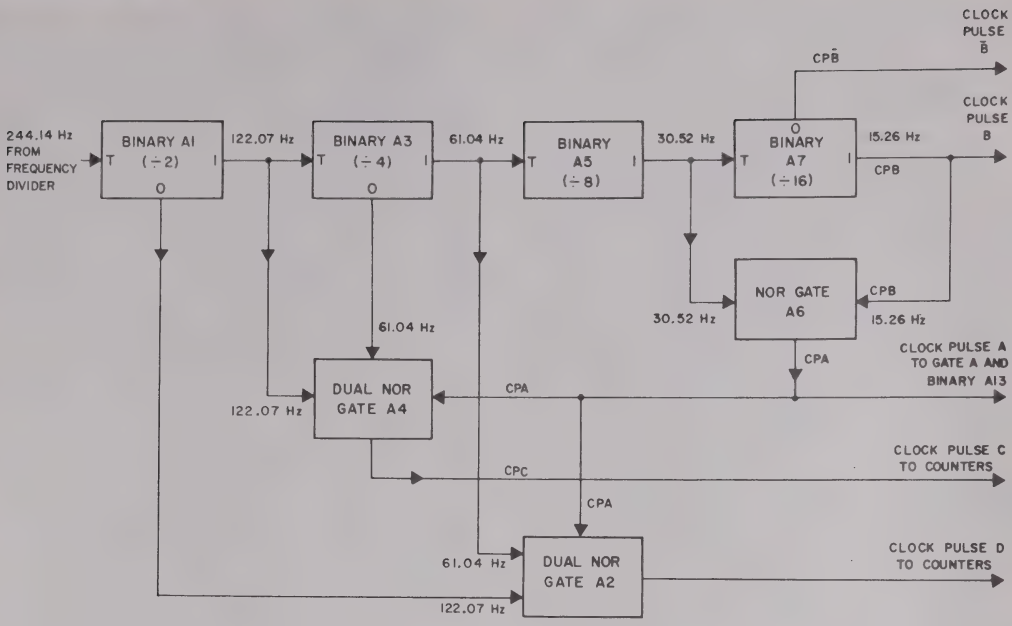
(2) The final referencing frequency of the programmed counter in the synthesizer must be low enough to allow several full cycles of the lowest modulating frequency to occur during each count cycle, in order to prevent the afc from drifting due to the modulating signal. The lowest modulating frequency is 200 Hz. The counter referencing frequency is 15.26 Hz over the portion of the band which includes a times-4 multiplication factor, and 10.15 Hz over the portion which includes a times-6 multiplication factor. The referencing rate is controlled by clock pulse B. Clock pulses A, C, and D are required for gating, set, and reset operation of the counter during the reference cycle. These pulses occur at the same rate as clock pulse B, but have a shorter time duration.

b. Block Diagram Analysis.

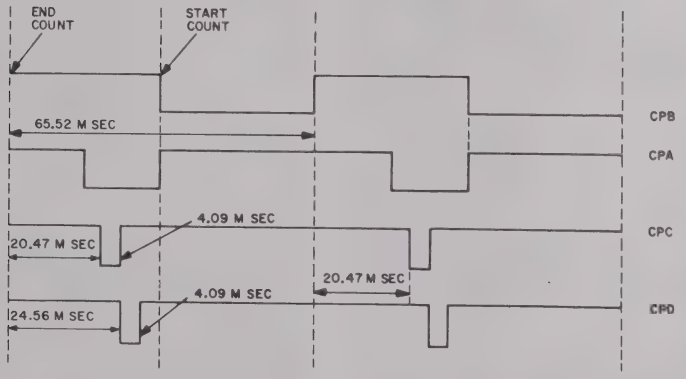
(1) *Clock pulse generator circuits* (fig. 2-8). The input to the clock pulse generator section of the unit is a 244.14-Hz square wave at 4 volts peak-to-peak over the times-4 portion of the band, and a 162.75-Hz square wave at 4 volts peak-to-peak over the times-6 portion of the band. This signal is further divided by 16 in a four-stage binary divider, A1, A3, A5, and A7. Clock pulse B is the non-inverted output of binary A7. Clock pulse B gates the non-inverted output of binary A5 in gate A6 to produce clock pulse A. Clock pulse C is the output of gate A4 and is derived by gating the non-inverted output of binary A1 with clock pulse A plus the inverted output of binary A3. Clock pulse D is produced in gate A2 by gating the inverted output of binary A1 with clock pulse A and the non-inverted output of binary A3. Clock pulse A is used to gate the rf signal applied to the programmed counter, and to reset the first binary of the counter chain. Clock pulse B establishes the *start count* and *end count* moments, as reference points for all other functions. Clock pulse C is the reset function; it occurs shortly after the *end count* moment and resets all binaries and the counters to *zero* state. Clock pulse D occurs immediately after clock pulse C ends and sets the programmed binaries to the *one* state.

(2) *Error pulse generator circuits* (fig. 2-9). There are two main inputs to the error pulse generator section: the output of the sixth rf divider (digital electronic divider-counter 5TR1A2A5 or 1RE1A2A5) in the frequency range 742 kHz to 1.13 MHz, and the full count (-) pulse from the programmed counter (digital electronic counter 5TR1A2A6 or 1RE1A2A6). The rf signal is gated by clock pulse A in dual NOR gate A8 (gate A) before clock pulse A is applied to the counter. Binary A13 is the first stage of the 16-stage counter and is reset by clock pulse A for convenience. The gated rf is also fed to the first count store (binary A9) and gate B (binary A10). The rf signal is then further divided by 5 non-programmed binary dividers contained in digital electronic counter 5TR1A2A6 or 1RE1A2A6 and digital electronic divider-counter 5TR1A2A5 or 1RE1A2A5. The full count (-1) pulse, generated when all 16 counter stages reach a *one* count simultaneously, is used to set the gate B (binary A10), which in turn, generates a full count pulse and an inverted full count pulse. These two pulses are then fed to the error pulse logic circuit which generates either a low count or a high count pulse.

The lack of synchronization due to the delay between the opening of gate A (binary A8) and the passage of the first pulse through it, results in a random low count and causes a jitter on the afc line. This jitter is removed by the action of the first count store (binary A9) and gate A12 of the error pulse logic circuit, which produce high count pulses equal to the random low count pulses. The high count or the low count error pulses are a succession of negative-going pulses whose widths depend upon the frequency error of the modulator-oscillator rf signal. The high count or the low count error pulses are then fed to signal data converter-storer 5TR1A2A8 or 1RE1A2A8 where they are used in generating the afc voltage.



CLOCK PULSE WAVEFORMS



NOTES

ABOVE FREQUENCIES AND TIME COMPARISON ARE REPRESENTATIVE OF DIVIDE-BY-TWO FUNCTION. FOR DIVIDE-BY-THREE FUNCTION CONVERT AS FOLLOWS:

FREQUENCIES		TIME COMPARISON	
÷2 FUNCTION	÷3 FUNCTION	÷2 FUNCTION	÷3 FUNCTION
244.14 Hz	162.75 Hz	65.52 M SEC	98.28 M SEC
122.07 Hz	81.375 Hz	32.76 M SEC	49.14 M SEC
61.04 Hz	40.688 Hz	24.56 M SEC	36.84 M SEC
30.52 Hz	20.344 Hz	20.47 M SEC	30.70 M SEC
15.26 Hz	10.17 Hz	4.09 M SEC	6.13 M SEC

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Figure 2-8. Clock pulse generator, functional block diagram.

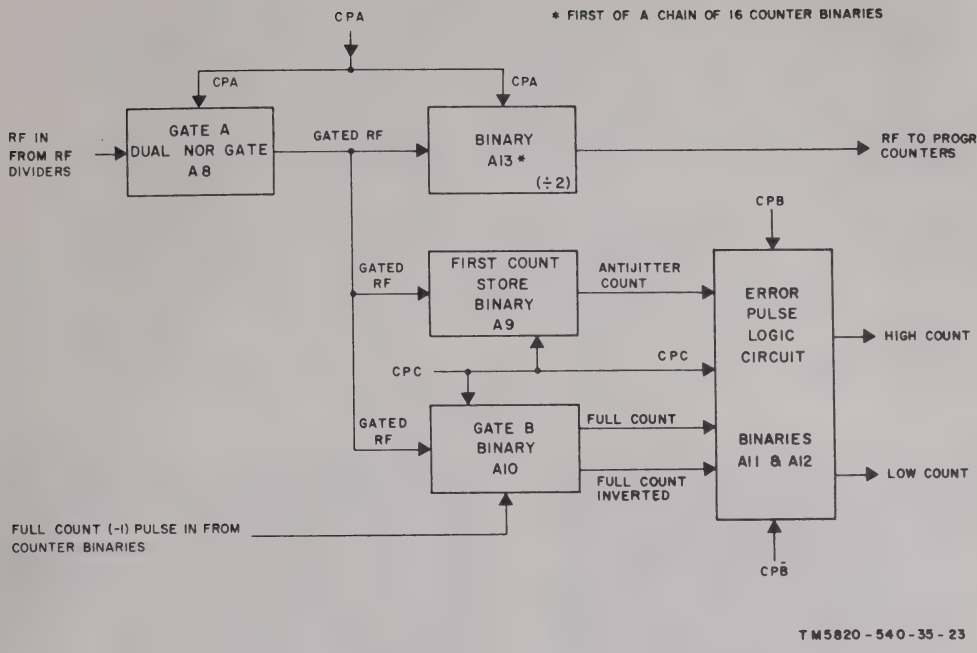


Figure 2-9. Error pulse generator, functional block diagram.

c. Detailed Circuit Analysis (fig. 6–7).

(1) *Clock pulse generator.* Clock pulse B establishes the counter start and stop times; the *start count* and *end count* moments. It is generated by dividing the 244.14 or 162.75 Hz signal a further 16 times through 4-stage binary divider A1, A3, A5, and A7. Clock pulse B is in the inverted output (pin 3) of binary A7 (fig. 2–10). The final frequency of clock pulse B is 15.26 Hz (or 10.17 Hz), depending on whether the transmitter multiplication factor is times–4 or times-6. These frequencies relate to referencing times of 65.53 milliseconds (or 98.,3 milliseconds). The start count moment is initiated by the negative transition of clock pulse B; the end count moment is coincident with the next positive transition of clock pulse B. The pin 8 output of binary A5 is fed to pin 7 of dual NOR gate A6; clock pulse B applied at pin 8 gates the output of binary A5 to produce clock pulse A (CPA) at pin 10. Clock pulse A is 65.53 (or 98.33) milliseconds long, consisting of a negative pulse 16.38 (or 24.57) milliseconds long followed by a positive pulse 49.15 (or 73.76) milliseconds long (fig. 2–11).

The output at pin 10 is fed into the second half of NOR gate A6 (pin 4); the output at pin

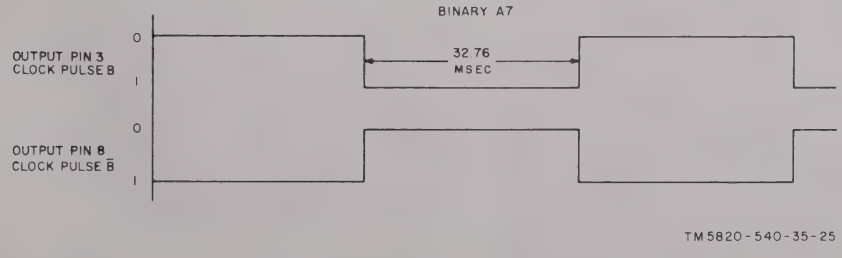


Figure 2-10. Clock pulse B generation.

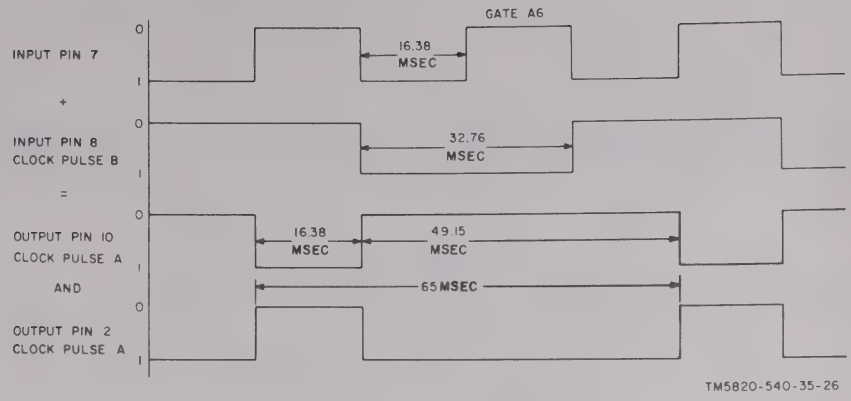


Figure 2-11. Clock pulse A generation.

2 is the inverted clock pulse A. CPA is fed to pins 3 and 9 of dual NOR gate A4 where it is used to gate the pin 3 output of binary A3 and the pin 8 output of binary A1, to generate clock pulse C (fig. 2-12). Clock pulse C (CPC) is a negative-going pulse 4.09 (or 6.14) milliseconds after CPA goes negative, or 12.27 (or 18.40) milliseconds before the start count moment. CPC is the *clear* or *reset* pulse fed to pin 4 of all programmed counters. Clock pulse D (CPD) is produced in NCR gate A2, by gating the pin 3 output of binary A1 and pin 8 output of binary A3 with CPA (fig. 2-13). CPD is a negative-going pulse 4.09 (or 6.14) milliseconds long starting 8.19 milliseconds after clock pulse A goes negative. CPD is the set pulse fed to pin 7 of all programmed counters.

(2) *Error pulse generator circuits.* The rf signal (rf÷64) at the output of the digital electronic divider-counter is fed through J7 pin 14 to pin 5 of gate A (dual NCR gate A8). Clock pulse A from pin 10 of NOR gate A6 is fed to pin 4 of gate A and gates the application of the rf signal to the counter. The gated rf from the first half of gate A is then fed through the second half of the gate to convert the rf signal before A is applied to pin 10 of the first counter stage, binary A13. Clock pulse A is fed to pin 4 of binary A13 to perform the reset function as a matter of convenience; all other counters are reset and set by clock pulses C and D respectively. The pin 8 output of binary A13 is then fed through J7 pin 13 to digital electronic counter 5TR1A2A6 or 1RE1A2A6 for counting. The gated rf signal at the output of gate A is also fed to the toggle inputs of binary A9 (anti-jitter) and binary A10 (gate B). The full count (–) pulse generated in digital elec-

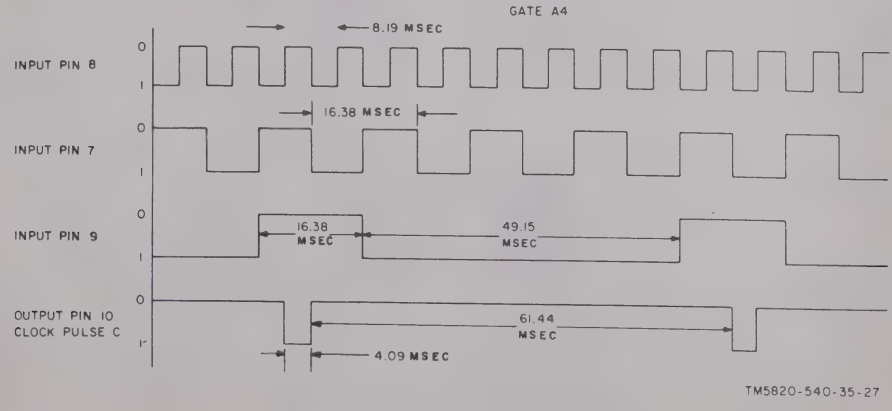


Figure 2-12. Clock pulse C generation.

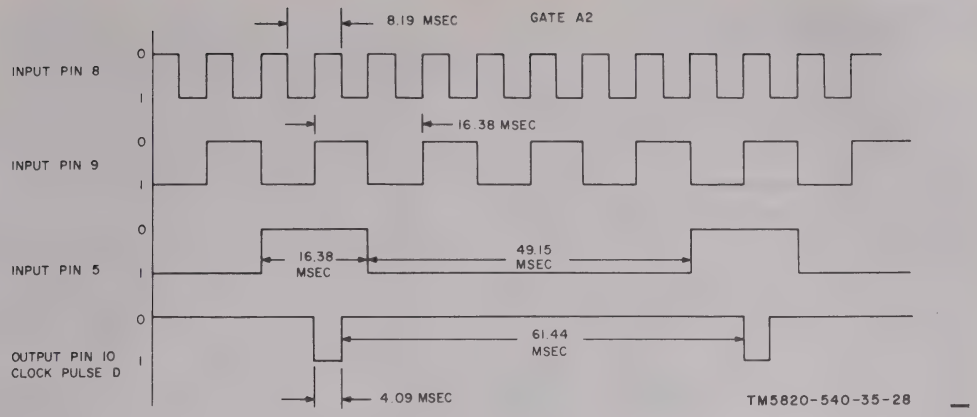


Figure 2-13. Clock pulse D generation.

tronic counter 5TR1A2A6 or 1RE1A2A6 (para 2–11) is fed through J7 pi n12 to the gating input pin 2, of gate B (binary A10). (The full count (–1) pulse is generated when all counter stages reach a *one* count simultaneously.) The next negative transition of the rf signal through gate A (binary A8) arriving at pin 10 of gate B, causes gate B to change states, generating the full count pulse at pin 8 and the inverted full count pulse at pin 3. Gate B is then reset to *zero* state by clock pulse C.

(*a*) The full count pulse at pin 8 of gate B is fed to pin 7 of NOR gate A12, while the inverted full count pulse at pin 3 of gate B is applied to NOR gate A11. NOR gates A11 and A12 form the *error pulse logic circuit.* The full count pulse fed to NOR gate A12 is referenced to clock pulse B applied to pin 8. Clock pulse A is fed to pin 9 of gate A12 to prevent any spurious low or high count pulses being generated during the counter resetting period. At the end count moment clock pulse B goes positive. The full count pulse goes negative at the time A10 is triggered. Thus, if the full count pulse occurs after the end count moment, the output at pin 10 of NOR gate A12 is a negative low count error pulse lasting from the end count moment to the moment the full count state has been reached. The inverted full count pulse at pin 3 of binary A10 is fed to pin 5 of NOR gate A11; the inverted full count pulse goes positive when A10 is triggered. Clock pulse B (CPB) (pin 8 output of binary A7) is applied to pin 4 of NOR gate A11 and is positive until the end count moment. If the full count moment occurs before the 'end count' moment, the output at pin 2 is a negative high count error pulse lasting from the moment the full count state has been reached to the end count moment. The negative high count error pulse is then fed into pin 8 of the second half of NOR gate A11. Input to pin 9 of A11 is the output (pin 3) of the anti-jitter binary which is negative at the start count moment, and pin 9 of A11 is held positive around the end count moment; the output at pin 10 of NOR gate A11 is a positive-going high count error pulse occurring near the end count moment if the modulator-oscillator frequency is high. This pulse is then fed into NOR gate A12 (pin 4) where it is inverted.

(*b*) The gated rf at the output of gate A (binary A8) is also fed to the toggle input (pin 10) of binary A9. Binary A9 is set to state zero by clock pulse C applied at pin 4, and remains in this state until it is switched by the first rf pulse through gate A. The output at pin 3 of A9 is negative after the start count moment until the first pulse passes gate A; this pulse is fed to A11 (pin 9) where it is combined with the high count pulse generated at A11 pin 2. The output from A11 pin 10 thus carries the high count pulse and the anti-jitter pulse. This is equivalent to a high count error pulse produced at the start count moment and is equal in time to the delay in counting resulting from the lack of synchronization between clock pulse A and the first rf pulse through gate A. During the anti-jitter pulse generation, the input to A11 pin 5 is positive, since no full count pulses are produced near the start count moment. The output of A11 pin 10 is then fed into pin 4 of NOR gate A12 where it is inverted. The low count and/or high count error pulses are then fed into signal data converter-storer 5TR1A2A8 or 1RE–1A2A8.

2–10. Programmed Counters (fig. 2–14)

a. The synthesizer frequency (any one of the 1,720 discrete output frequencies) is referenced to, and controlled by, the 2.0-MHz reference crystal oscillator (rf oscillator 5TR1A2Y1 or 1RE1A2Y1). The frequency referencing and control are done in a sampling manner to permit frequency deviation of the output signal. The sampling rate is related to the lowest modulating frequency, and is low enough to prevent the modulating signal from having an effect on the frequency controlling function. The lowest modulating frequency is 200 Hz; the frequency referencing rate has been established at 15.26 Hz (divide-by-2 function) or 10.17 Hz (divide-by-3 function).

b. The frequency referencing rate is established by dividing the output of the 2.0 MHz crystal oscillator (rf oscillator 5TR1A2Y1 or 1RE1A2Y1) to 15.26 Hz (65.52 milliseconds) or 10.17 Hz (98.33 milliseconds). A sample of the modulator-oscillator output frequency is fed through the programmed ripple counter which should give a one count in every stage (full count) at precisely the same time as the sampling time interval ends (end count moment). If the *one* count is reached before or after the end moment, high or low count error pulses are produced; these in turn vary the afc voltage in the proper direction to bring the modulator-oscillator output frequency to the nominal value.

c. To permit the selection of the synthesizer output frequencies (channel selection), certain stages of the programmed ripple counter are preset according to the frequency selection code. By changing the preset code, the time required for any particular frequency to establish full count condition also changes. This in turn causes the afc to change the modulator-oscillator output frequency to the point where the full count occurs at the end count moment. The preset code is established in control indicator 6A3 or 2A2 (para 2–27).

d. The ripple counter consists of a total of 16 binary dividers connected in series, with the output of each binary feeding a 16-input NOR gate (fig. 2–14). The gate produces a full count output when all 16 stages reach the one state. In order to establish the correct counter working range (about 1 MHz), the sample of the synthesizer output frequency is first divided in six high speed dividers (para 2–3) to a frequency in the range of 0.742 MHz to 1.13 MHz. This signal is then fed into electrical synchronizer 5TR1A2A7 or 1RE1A2A7 and gated by clock pulse A in gate A. The gated rf is applied to the counter at the start of the counter referencing time (*start* count). The first binary of the 16-stage counter is contained in the electrical synchronizer. During the period the rf signal is gated-off (quiet period), all counter stages are set to *zero* state by clock pulse C, and immediately after, certain selected states are preset to the *one* state by clock pulse D, according to the information code arriving on control lines 3–12 from control-indicator 6A3 or 2A2. The first six divider stages (one in the electrical synchronizer and five in digital electronic counter 5TR1A2A6 or 1RE1A2A6) are all preset to the *one* state by clock pulse A, clock pulse C, or control lines 1 and 2. Their function is to provide fine frequency resolution and to reduce the amount of correction required of the anti-jitter circuit. The remaining 10 dividers are preset by control-indicator control lines 3 to 12 to produce the selected frequency.

e. The frequency control information is in the form of a binary code (para 2–27). Each suceeding control line controls twice as much frequency change as the one preceding it. Thus control line 3 controls a frequency change of 125 kHz or 83.333 kHz; line 4 controls a frequency change of 250 kHz or 166.666 kHz; and line 12 controls a frequency change of 64 MHz or 42.666 MHz, depending whether the sampling interval is 32.76 milliseconds (channels up to 179) or 49.166 milliseconds (channels 180 and up).

f. For example, to select a transmitter output frequency of 256 MHz, channel code 112 on the channel selector will preset line 12. Since the transmitter multiplication factor is times-4 at channel 112 the required synthesizer output frequency is 64.0 MHz. The six binary dividers that precede the counter reduce the modulator-oscillator output frequency to 1.0 MHz before it is applied to the counter. With line 12 preset it will take 32.76 milliseconds for the counter to generate the full count pulse. This signal equals the 32.76-millisecond counter reference time established by the reference rate of 15.26 Hz (clock pulse B). To increase transmitter output frequency by one channel, line 3 is preset with line 12 as the channel selector is set to channel 113. Presetting line 3 will initially decrease the time it takes to generate the full count pulse by 64 microseconds, causing low count error pulses which change the afc the correct amount to increase the vco frequency by 125 kHz to the point where the full count pulse again occurs at the end count moment. To decrease transmitter fre-

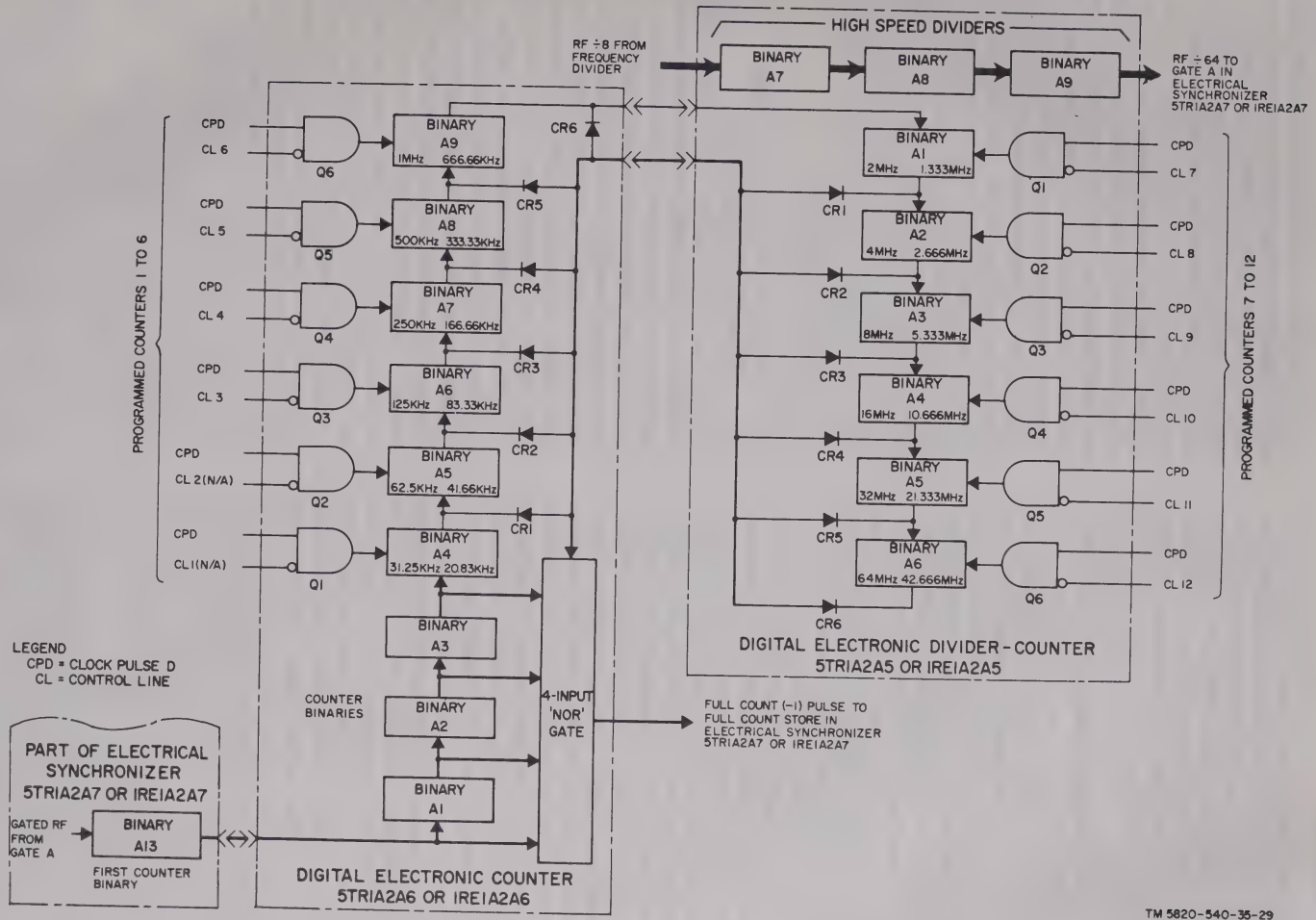


Figure 2-14. Programmed counters, functional block diagram.

quency by one channel to channel 111, the channel selector code removes line 12 preset and presets all other 9 stages in accordance with the binary counting code. This then increases the time to generate the full count pulse by 64 microseconds and causes the vco frequency to shift downward by 125 kHz.

2–11. Digital Electrical Counter 5TR1A2A6 or 1RE1A2A6

a. General. The digital electronic counter contains three non-programmed binary counters (A1, A2, and A3), six programmed binary counters A4 through A9, and one 4-input NOR gate operating as a 16-input *AND* gate. All binaries are connected in a counterfashion with the rf signal at the zero output (pin 3) being connected to the toggle input (pin 10) of the next binary. The zero output of all binaries is used to originate the full count (–1) pulse.

b. Detailed Circuit Analysis (fig. 6–8). The output of binary A13 of electrical synchronizer 5TR1A2A7 (first binary counter), a 4-volt peak-to-peak square wave, is fed into the toggle input of binary A1, and to the full count gate (4-input NAR gate) A10, pin 10. Similarly, the outputs of binaries A1, A2, and A3 are also fed to the full count gate A10 (pins 7, 8 and 9 respectively). Binaries A1, A2, and A3 are preset to state *one* (*zero* state at pin 3) by clock pulse D fed to gating input pin 7 of each binary. Binaries A4 through A9 are programmed working in conjunction with control lines 1 through 6 of control-indicator 2A2 or 6A3. Control lines from the control-indicator are applied to the bases of transistors Q1 through Q6. Clock pulse D is applied to the emitters of transistors Q1 through Q6. Transistors Q1 through Q6 operate as AND gates with control lines gating clock pulse D application to the counter stage. The first two control lines (lines 1 and 2) are not used; the corresponding microswitches in the control-indicator are open. Clock pulse C applied to pin 4 of each binary sets it to state *zero* (pin 8). Clock pulse D arriving at binaries A4 and A5 through gates Q1 and Q3 presets them to state *one* (*zero* state at pin 3). The *zero* state at pin 3 is sensed by CR1 and CR2 respectively.

(1) Control lines 3 through 6 carry the control-indicator binary coding (para 2–27). When a control line is off (uncoded) the corresponding microswitch is closed, grounding the base of its corresponding transistor, thus preventing clock pulse D from getting through. The programmed binary remains at state *zero* (pin 8) and is switched to state *one* by the next negative transition. Diodes CR3 through CR6 sense state *zero* at pin 3 of each binary counter. CR1 through CR6 are part of a 12-input gate extender used to extend the inputs to the full count gate A10 from 4 to 16.

(2) The rf at the pin 3 output of binary A9 is fed through J6 pin 6 to the next six programmed counters contained in digital electronic divider-counter 5TR1A2A5 or 1RE1A2A5. The extender line from counter stages 7–12 is connected through J6 pin 8 to the extender line of the first six counter stages, and then fed to the gating input, pin 2, of the full count gate. The negative-going full count (–1) pulse is generated the instant all inputs sensed (2 and 7 through 10) become *zero* simultaneously. The full count pulse is then fed through J6 pin 1 to the full count store, binary A10, in electrical synchronizer 5TR1A2A7 or 1RE1A2A7.

2–12. Digital Electronic Divider-Counter 5TR1A2A5 or 1RE1A2A5

a. General. The digital electronic divider-counter contains six programmed binary counters A1 through A6 (stages 7 through 12) and the three last stages of the high speed dividers. Binaries A1 through A6 are connected in the same counter fashion as counter stages 1 through 6 in digital electronic counter 5TR1A2A6 or 1RE1A2A6 (para 2–11).

b. Detailed Circuit Analysis (fig. 6–9).

(1) The operation of programmed counter binaries A1 through A6 is identical to that of counter binaries A4 through A9 in the digital electronic counter (para 2–11). The counter input is available to the first binary from J5 to pin 5 and clock pulse C is fed through J5 to pin 7 to pins 4 of each binary. Clock pulse D is fed from J5 to pin 9 to the bases of transistors Q1 through Q6, while control lines 7 through 12 are applied from J5 pins 10 through 15 and individual 22k resistors to the emitters of transistors Q1 through Q6 respectively. CR1 through CR6 sense the *zero* state at pin 3 of each binary and the extender line is fed through J5 pin 8 and J6 pin 8 to the full count (–1) gate in digital electronic counter 5TR1A2A6 or 1RE1A2A6.

(2) Binaries A7 through A9 are integrated microcircuit binary dividers and have been mounted on this board for convenience. The rf input (rf ÷ 8) is applied through J5 pin 1 and C2 to toggle input pin 10 of binary A7. The two anti-phase outputs at pins 3 and 8 are at half the input frequency. R7 and R13 lower the output im-

pedance to speed up the switching action. The output at pin 3 is fed into toggle input pin 10 of the next binary A8, and similarly the A8 output at pin 3 is fed into the toggle input of binary A9. R8 and R9 speed up the switching action of binaries A8 and A9 respectively. The output at pin 8 of binary A9, (rf ÷ 64) is coupled through C1 to J5 pin 6 and then fed to electrical synchronizer 5TR1A2A7 or 1RE1A2A7 for gating and counting.

2–13. Signal Converter-Storer 5TR1A2A8 or 1RE1A2A8

a. General. The only function of signal data converter-storer 5TR1A2A8 or 1RE1A2A8 is the conversion and integration of high count and low count error pulses to a dc automatic frequency control (afc) voltage. The afc voltage is then fed through amplifier-monitor 5TR1A2A3 or 1RE–1A2A3 to modulator-oscillator 5TR1A2A2 or 1RE1A2A2 where it is used to control the synthesizer output frequency.

b. Block Diagram Analysis (fig. 2–15). The low count and high count error pulses fed into the signal data converter-storer are negative-going pulses at 4 volts peak-to-peak, whose width depends on the actual frequency error of the modulator-oscillator output frequency. The low count error pulses are fed through a two-stage amplifier (Q1–Q2) and a diode to a pair of low leakage capacitors in the gate circuit of a metal oxide semiconductor field effect transistor (FET), Q6. The two-stage amplifier is operated in saturation and acts as a switch which applies a constant amplitude voltage pulse to the capacitors. As the width of low count pulses indicates the frequency error, the length of time that the switch is open determines the amount of voltage charge built up on the capacitors. The high count error pulses and the anti-jitter pulses are fed through a three-stage amplifier and reversed diode to the same pair of capacitors. Thus the opposing error pulses operate in the same manner but in opposite directions. The voltage appearing at the drain output of Q6 is the afc voltage. High count error pulses (and anti-jitter pulses) cause a decrease in the afc voltage while low count error pulses cause an increase in the afc voltage. The source voltage fed to Q6 is adjusted by a bias control to set the nominal afc working voltage. The afc voltage is then fed to amplifier-monitor 5TR1A2A3 or 1RE1A2A3.

c. Detailed Circuit Analysis (fig. 6–10).

(1) Low count error pulses from electrical synchronizer 5TR1A2A7 or 1RE1A2A7 are fed into the signal data converter-storer at J8 pin 11, and are coupled through C1 to the base of Q1. Transistor Q1 is normally conducting but upon receipt of a negative-going low count error pulse, Q1 cuts off, causing Q2 to conduct and draw 2 ma. (0.6 ma is drawn from the +12v line (transmitter) through R4, and 1.4 ma is drawn from the integrating circuits C3 and C4 through diode CR1). From Q1 collector the pulses are coupled through Q2, CR1, and a jumper between relay K1 contacts A2 and A3 to the low leakage capacitors C3 and C4.

(2) Similarly, high count error pulses are fed into the signal data converter storer from J8 pin 10 and coupled through C2 to the base of Q3. Transistor Q3 acts as a switch, normally con-

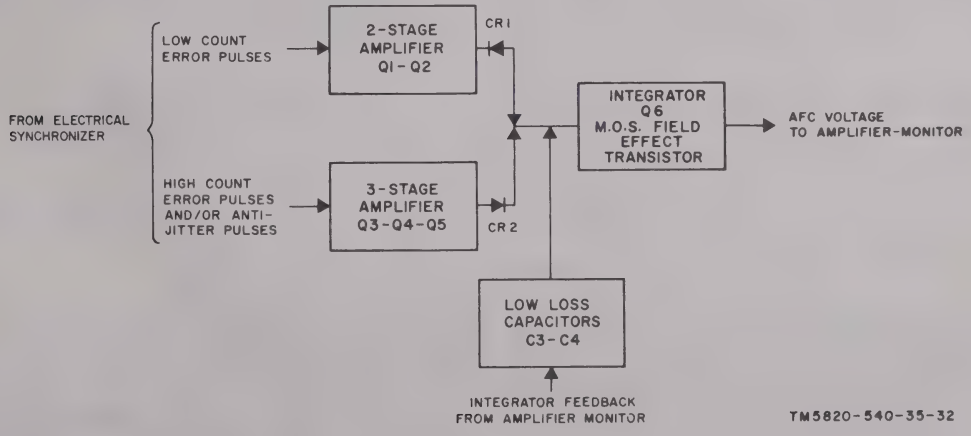


Figure 2-15. Signal data converter-storer 5TR1A2A8 or 1RE1A2A8, block diagram.

ducting. When negative-going anti-jitter pulses (at the start count moment) or high count error pulses are received at the Q3 base, Q3 is cut off and the pulses are coupled through Q4 to PNP transistor Q5. Q5 inverts them and then CR2 passes them on to C2 and C3 through the K1 contact jumper. C3 and C4 are connected in the gate circuit of field effect transistor Q6. The source supply to Q6 is adjusted by bias control R15 to establish the nominal afc voltage during setup. The output of Q6 at the drain is the afc drive to amplifier-monitor 5TR1A2A3 or 1RE1A2A3. The integrator feedback (J8 pin 9) is fed to the return side of low leakage capacitors C3 and C4 and is taken from the output of the feedback amplifier Q3 in the amplifier-monitor (para 2–14).

NOTE

The dynamic frequency store circuit, shown in the schematic diagram (fig. 6–10), is not used at all; the circuit, however, has not been removed to date. The jumper between relay K1 contacts A1 and A3 insures continuity of the signal path, and the absence of an incoming signal at J8 pin 7 keeps the circuit inoperative.

2–14. Amplifier-Monitor 5TR1A2A3 or 1RE1A2A3

a. General. Amplifier-monitor 5TR1A2A3 or 1RE1A2A3 amplifies the afc voltage to the required range for frequency control, monitors the afc voltage and the presence of clock pulse D, and gives an alarm indication if frequency control is lost. This unit also provides the integrator feedback voltage to signal data converter-storer 5TR1A2A8 or 1RE1A2A8.

b. Block Diagram Analysis (fig. 2–16). The afc voltage at the output of the field effect transistor is fed to a two-stage cascade emitter follower, Q1,–Q2, to adjust the afc voltage to the 2-9-volt range required at modulator-oscillator 5TR1A2A2 or 1RE1A2A2. An inverted sample of the output afc is amplified in Q3 and fed back to the return side of the two low-leakage capacitors in the field effect transistor gate circuit in the signal data converter-storer as the intergrator feedback circuit.

(1) The integrator feedback voltage is monitored and used to control the SYNC alarm relay K1. The SYNC alarm relay is normally operated by current through control transistors Q4–Q5, and drops out in the event of overvoltage or undervoltage. The normal current through the control transistor is preset by a SYNC alarm control.

(2) Clock pulse D is differentiated and fed to capacitor discharge transistor Q6. Loss of clock pulse D causes the capacitor to build up a voltage which overcomes the Zener diode bias and turns on control transistors Q4 and Q5, causing the SYNC alarm relay to drop out.

c. Detailed Circuit Analysis (fig. 2–17).

(1) *Afc circuit.* The afc drive at J4 pin 11 is fed through R11 to the base of Q1. The Q1 emitter is connected directly to the base of Q2, the output emitter follower; the afc signal at the Q2 emitter is then fed through J4 pin 5 to modulator-oscillator 5TR1A2A2 or 1RE1A2A2. The afc voltage in the range of 2 to 9 volts is applied to the oscillator varactor in the modulator-oscillator board to generate output frequencies of 47.5 to 72.5 MHz (para 2–4).

(2) *Integrator feedback.* The voltage at the collector of Q2 is amplified in feedback amplifier Q3. The signal at the Q3 collector is fed through J4 pin 7 to the return side of the two low leakage capacitors, C3, and C4, of the integrator circuit in the signal data converter storer 5TR1A–2A8 or 1RE1A2A8.

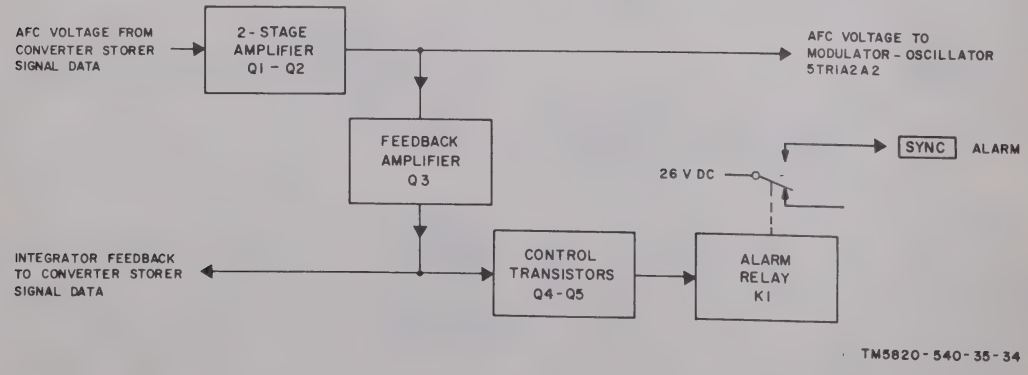
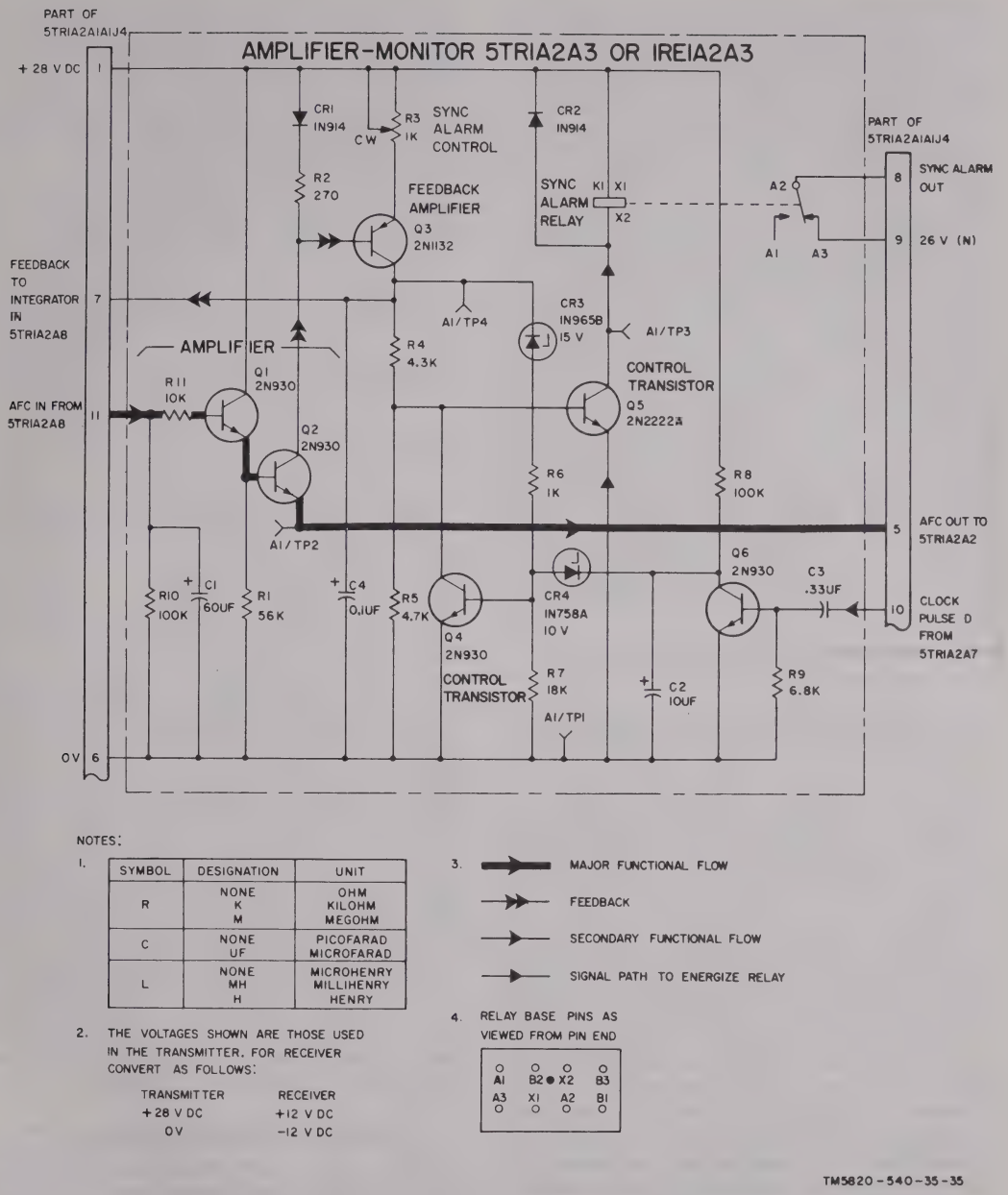


Figure 2-16. Amplifier-monitor 5TR1A2A3 or 1RE1A2A3, block diagram.



NOTES:

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. THE VOLTAGES SHOWN ARE THOSE USED IN THE TRANSMITTER. FOR RECEIVER CONVERT AS FOLLOWS:

TRANSMITTER	RECEIVER
+28 V DC	+12 V DC
0V	-12 V DC

3. MAJOR FUNCTIONAL FLOW
FEEDBACK
SECONDARY FUNCTIONAL FLOW
SIGNAL PATH TO ENERGIZE RELAY

4. RELAY BASE PINS AS VIEWED FROM PIN END

TM5820-540-35-35

Figure 2-17. Amplifier-monitor 5TR1A2A3 or 1RE1A2A3, schematic diagram.

(3) *SYNC alarm operation.* The SYNC alarm circuit operates when the afc voltage is either below or above set limits or when clock pulse D is absent. Normally, relay K1 is kept operated by current through control transistor Q5. The base of Q5 is connected in a voltage divider circuit and senses the current through control transistor Q4. The afc reference voltage is taken from the collector of Q3, the feedback amplifier. Since Q3 is a PNP transistor, a rising volt-

age at its base (equivalent to a drop in afc output voltage) will tend to cut it off. This will cause the voltage at the Q3 collector to fall, pulling down the Q5 base through R4. Q5 will then cut off, letting K1 drop out. The SYNC alarm path through relay K1 contacts is open and the SYNC alarm is on. If the output afc increases above its reference value, the Q3 base will drop causing its collector to rise above 15 volts and fire Zener CR3. This will cause the Q4 base to rise, turning Q4 on. When Q4 conducts, its collector will fall, lowering the Q5 base. Q5 will then cut off, letting K1 drop out and indicate an alarm condition. Afc SYNC alarm operation is adjusted by control R3, which varies the current through Q3. Clock pulse D at J4 pin 10 is differentiated by C3 and R9 producing positive pips at the Q6 base. These positive pips cause Q6 to discharge C2. If clock pulse D fails, the discharge action stops and the C2 voltage builds up toward the supply voltage. When it reaches 10 volts, Zener CR4 fires, raising the Q4 base voltage, turning Q4 on and causing Q5 base voltage to fall. Q5 cuts off and lets relay K1 drop out, to indicate a SYNC alarm.

2–15. Interconnecting Box 5TR1A2A1 or 1RE1A2A1

a. General. The interconnecting box 5TR1A2–A1 or 1RE1A2A1 provides all the interconnecting facilities between the nine various printed circuit boards and to the two external connectors J11 and P2 of the synthesizer. J11 connects the synthesizer to the transmitter fixed head or receiver fixed head chassis. P2 connects the synthesizer to amplifier-frequency multiplier 5TR1A4 or 1RE1A4.

b. Detailed Circuit Analysis (fig. 6–11). +28V dc is applied through P2 pin 1 and resistors R2 through R13 to the AND gates of the programmed counters in digital electronic counter 5TR1A2A6 or 1RE1A2A6 and digital electronic divider-counter 5TR1A2A5 and 1RE1A2A5. +28V dc is also applied through R14 to the divide-by-3 (line 13) circuits in rf oscillator 5TR1A2Y1 or 1RE1A2Y1. When a control line is coded, the corresponding microswitch in the control-indicator is open; +28V dc is applied through a resistor in the base of the corresponding transistor gate and allows clock pulse D to preset the counter to *one* state (pin 8). When a control line is not coded, the corresponding microswitch in the control indicator is closed, grounding the base of the transistor and preventing clock pulse D from getting through to the respective binary.

(1) Filter FL1 couples a portion of the rf output from modulator-oscillator 5TR1A2A2 or 1RE1A2A2 to the high speed divider in frequency divider 5TR1A2A4 or 1RE1A2A4. The purpose of FL1 is to prevent any harmonics of the output signal from being coupled from the high speed dividers back to the output line.

(2) The voltages available to operate the synthesizer are different in the transmitter from those in the receiver. The voltages available are:

Transmitter Duty (Supplied)	28v dc regulated	P2 pin 1
	+12v dc regulated	P2 pin 2
	0v dc	P2 pin 3
	26v (N)	P2 pin 5
	+28v dc regulated	P2 pin 37
Receiver Duty (Supplied)	+12v dc regulated	P2 pin 1, 37, 38
	0v dc	P2 pin 2
	–12v dc regulated	P2 pin 3
	26v (N)	P2 pin 5

(3) Two additional voltages are required by various circuits in the synthesizer:

Transmitter Duty:	+20v dc	E29
	+16v dc	E28
Receiver Duty:	+8v dc	E29
	+4v dc	E28

(4) These additional voltages are provided by a power supply divider circuit; CR1, CR3, R1, and R20. Zener diodes CR1 4.3v and CR2 8.2v provide regulation. The 4-volt discrepancy between the voltage available for transmitter duty as opposed to receiver duty is taken care of by dropping the extra voltage in a load resistor.

(5) In order that the synthesizer can be interchanged between the transmitter and receiver, the regulated dc return paths are connected to the respective power supply ground points rather than being grounded within the unit.

(6) C1, C2, C4, C5, and C6 are used to filter the +12v, +28v, +20v, 0v, and +16v supplies respectively. CR3, CR4, CR5, and R15 are part of the afc hold circuit which is not used. R19 provides a termination for the rf ÷ 8 signal.

2–16. Amplifier-Frequency Multiplier 5TR1A4

a. General. Amplifier-frequency multiplier 5TR1A4 doubles the output frequency of synthesizer 5TR1A2, and amplifies the resulting signal to the level required by subsequent multipliers in the transmitter frequency generating chain.

b. Block Diagram Analysis (fig. 2–18). The synthesizer modulated rf output in the range of 47.5 to 72.5 MHz, at a level of +13 dbm ±1 db,

is first fed to low pass filter FL1. The low pass filter attenuates all unwanted harmonics generated by the synthesizer, which would otherwise lower the efficiency of the doubler circuit. The rf signal at the output of the filter is applied to a 4–to–1 transformer T1, which converts the unbalanced input line to a balanced input to full-wave rectifier CR1. CR1 consists of a matched pair of hot-carrier diodes. Hot-carrier diodes provide efficient frequency doubling with low spurious outputs. The rectifier output circuits are balanced to remove the fundamental input frequency and all odd harmonics. Total conversion loss is about 8 db; the resulting signal, about +5 dbm, is applied to three-stage, stagger-tuned, medium-power amplifier Q1, Q2, and Q3. The first stage provides maximum gain at the low end of the output frequency range while the second stage provides maximum gain at the high end of the output frequency range. The third stage is a high power unit providing maximum gain at the middle of the output frequency range. The overall gain of the amplifier is about 32 db. The output of the amplifier is then coupled through a 1-db matching network to a tuned pi-type rf filter which attenuates all unwanted harmonic signals. The output signal is in the range of 95 to 145 MHz at 3 watts; output impedance is 50 ohms and fm deviation of the output signal is doubled during the frequency doubling process. A dc metering signal derived from the output signal provides an indication of the actual power delivered to the frequency multiplier chain (DOUBLER metering).

c. Detailed Circuit Analysis (fig. 6–12). The synthesizer rf output is fed through P1–A1 to low pass filter FL1. FL1 is a conventional lc-type low pass filter mounted on a separate board. The unbalanced output of FL1 is coupled through C8 to terminals 1 and 2 of transformer T1. The output at pins 3 and 5 of T1 is balanced to ground and stepped up in voltage four times to increase the efficiency of full wave rectifier CR1. Balanced tuning circuits L6, C10, R1, and L5, C9, and R2 eliminate the fundamental frequency and all odd harmonics of the fundamental. Balance of the two sides of the rectifier output is achieved by adjusting R1 and R2, the harmonic reject potentiometers. The output of the rectifier at twice the input frequency is then coupled through C11, C12, C14, L8, and C19 to the base of Q1, the first stage amplifier. C14 is adjusted for optimum input matching to Q1. The output at the collector of Q1 is coupled through C21 and L11 to the base of Q2. C22 adjusts the low-frequency portion (95 to 120 MHz) of the first amplifier stage response. The signal at the Q2 collector is then coupled through C26 and L13 to the base of Q3. The response of the second amplifier stage is tuned by C26 and C27 to favor the high frequency portion (120 to 145 MHz) of the input. The Q1 and Q2 base voltages are derived from the +28v dc line through voltage dividers R8, and R5 for Q1, and R8 and R10 for Q2. The base voltage is filtered by C17 and C23 and kept constant at 6v by Zener diode CR3. The first two stages of amplification provide a controlled gain of approximately 10 db each. Q3 is a high power wideband output amplifier. C31 adjusts the response of Q3 to the center portion of the input, and Q3 provides approximately 12 db-gain from 95 to 145 MHz.

(1) The signal at the collector of Q3 is coupled through L16 and C32 to a 1-db resistive network, R13, R14, R15, and R16, for impedance matching before the signal is filtered in a pi-type low pass filter, L18, L19, C35, L20, C36, and L21. C35 and C36 adjust the response of the low pass filter. The filtered output at twice the synthesizer output frequency is then coupled through C37 to output connector P1 pin A2, for distribu-

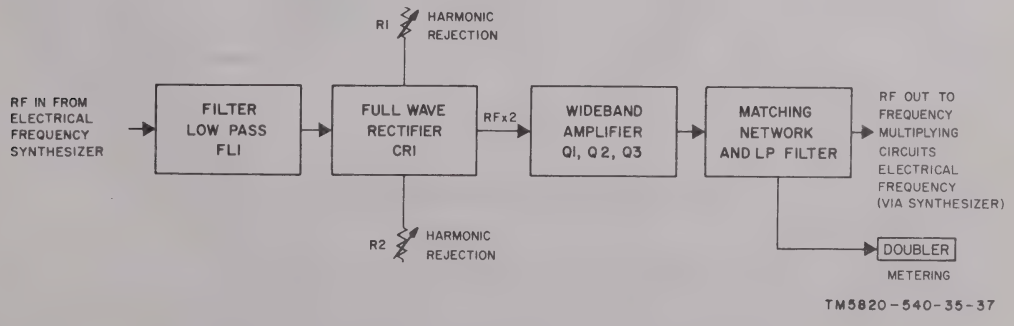


Figure 2-18. Amplifier-frequency multiplier 5TR1A4, block diagram.

tion to the frequency multiplying circuits in the transmitter rf head.

(2) The metering signal (DOUBLER) is derived from the voltage drop across L15 in the Q3 collector circuit, rf filtered by C33 and FL1, then made available at P1 pin 10. The metering return line at P1 pin 12 is decoupled to rf by L17, R17, and C34. Diode CR1 across the metering circuit provides scale expansion.

(3) The automatic level control (alc) circuit, pin diode CR2, is not used in the BAND I configuration. The alc line at P1 pin 17 is grounded in the transmitter rf head. Resistor R18 is an additional load for the +12v dc supply to the synthesizer (P2 pin 2 of 5TR1A2) and has been located in this unit for convenience. The +28v dc supply to the amplifier-frequency multiplier is brought in directly through connector P2 pin 37 and J11 pin 1 of synthesizer 5TR1A2 to P1 pin 1.

2-17. Alarm Control 5TR1A3

a. General. Alarm control 5TR1A3 operates in conjunction with power monitor 6AR1A3 in the transmitter rf head to provide a warning in the form of both audible and visual alarms when the transmitter output power falls 8 db below its normal level. The alarm control operates from a center-tapped, 400 Hz supply.

b. Block Diagram Analysis (fig. 2-19). Power monitor 6AR1A3 rectifies a sample of the rf output signal into a dc signal. This low level dc signal (0.25v minimum) is used to keep one side of a low drift balanced dc amplifier (Q1-Q2) conducting and alarm relay K1 energized. If the dc signal falls below the required compensating voltage, the dc amplifier is cut off and the relay drops out, causing the LOW POWER alarm light to go on and the buzzer to sound. The alarm condition comes on when the output level is 8 db below the nominal transmitter output level, and is cut off when the output level returns to about 6 db below nominal. The 2-db tolerance has been introduced to prevent the relay from chattering when the power level remains stable around the trip point.

c. Detailed Circuit Analysis (fig. 2-20). The incoming dc signal derived from power monitor 6AR1A3 is applied to the base of Q2. Q1 and Q2 are part of a balanced dc amplifier of the long tail pair (R8) configuration. A compensating dc voltage is applied to the base of Q1 from bias voltage divider R1 through R7. The 52v supply is derived from a center-tapped winding of the 400 Hz inverter transformer in power supply 5TR1PS1. This ac supply is rectified by CR1 and CR2, and the resulting 24v dc is smoothed by R13 and C1 and stabilized by Zener diode CR4. R5, R6, and R7 in parallel with R3, allow for a very fine voltage adjustment of the Q1 base voltage by restricting the adjustment range of R7. R7 is adjusted so that the base of Q1 is somewhat positive with respect to ground. When no dc is available from the power monitor, Q2 is cut off, and so are Q3 and Q4; relay K1 is deenergized and the alarm condition is on, the buzzer sounds and the LOW POWER alarm light is on. As the output power of the transmitter increases, Q2 begins to conduct and Q1 is cut off;

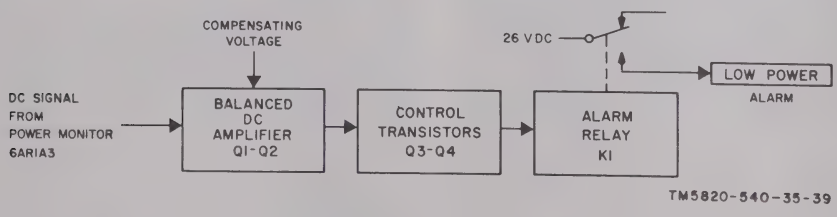
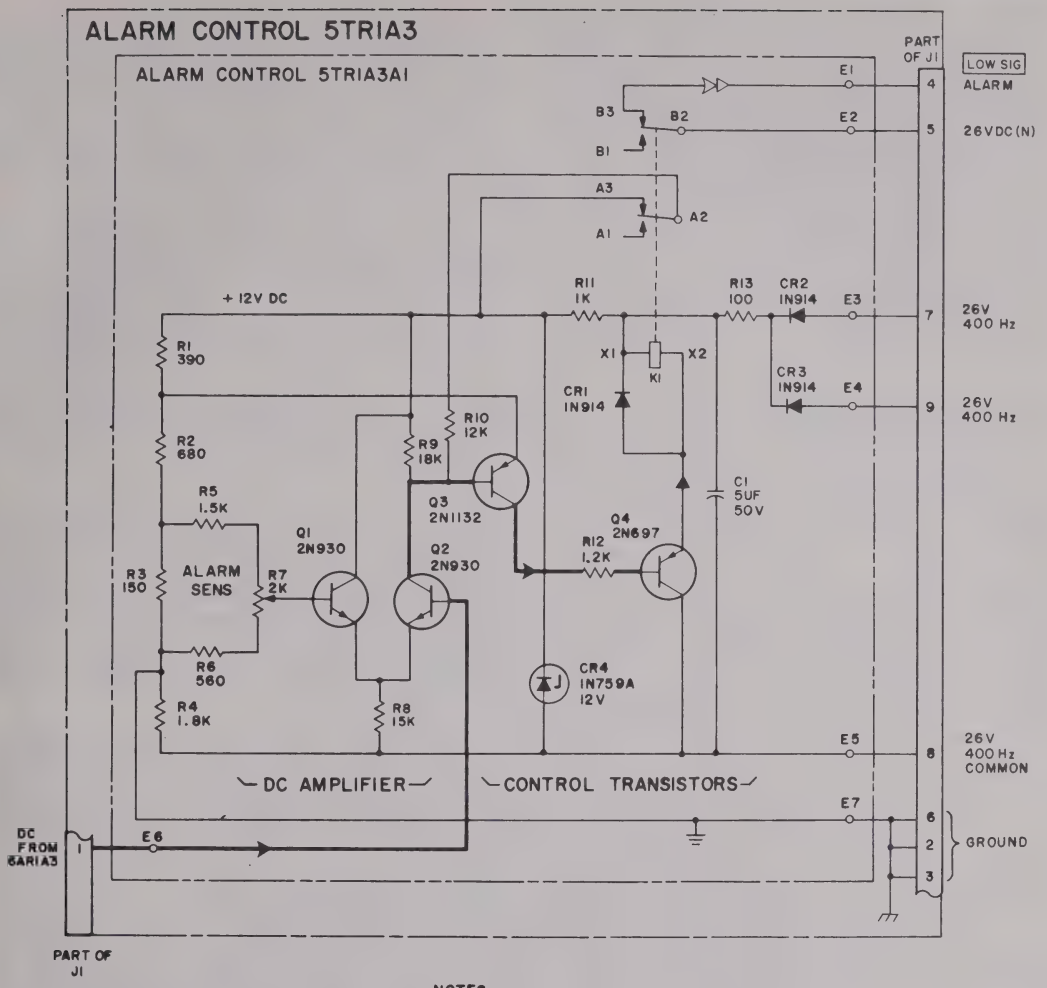


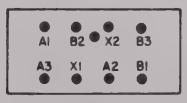
Figure 2-19. Alarm control 5TR1A3, block diagram.



NOTES

1-

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2- 

RELAY BASE PINS AS VIEWED FROM THE PIN END.

3- FAULT SIGNAL TO PROVIDE INDICATION.

SIGNAL PATH TO ENERGIZE RELAY.

SECONDARY FUNCTIONAL FLOW.

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Figure 2-20. Alarm control 5TR1A3, schematic diagram.

this action taking place at a sharply defined point of operation. At a certain point in the conduction of Q2, Q3 starts to conduct; this happens when the voltage drop across R9 is equal to the voltage drop across R1 plus an additional 0.5v (Q3 emitter-base threshold). When Q3 conducts, Q4 also conducts and relay K1 becomes energized; this is the normal position. When K1 is energized, the LOW POWER alarm circuit is open. Resistor R10, switched into and out of the Q3 circuit by relay K1 contacts, provides some backlash to the circuit. CR1 protects Q4 against large inductive spikes which can occur when Q4 cuts off.

2–18. Power Supply 5TR1PS1

a. General. Power supply 5TR1PS1 provides all the regulated and unregulated dc and ac supplies used throughout the transmitter fixed and rf heads. It provides regulated supplies of 12v and 28v dc used in the active circuits, 26v dc unregulated to relays and alarm circuits, 630v dc unregulated plate supply to the power amplifier tubes in the transmitter rf head, two supplies of 7.2v dc unregulated for the heaters of the power amplifier tubes, 128v ac, 400-Hz square wave for the blower motor, and a 52v ac, 400-Hz square wave output for the alarm control. It also contains current regulators for the cathode supply to power amplifier tubes in the transmitter rf head. A high voltage surge protector is connected at the line input to the unit. Further over-voltage protection is provided immediately following the choke-input filter. The regulators are current-limited for short circuit protection. The inverters are provided with starting circuits to provide immediate operation upon application of power. Power suppy 5TR1PS1 consists of four subassemblies, interconnected by a wiring harness.

b. Block Diagram Analysis (fig. 2–21). The 115v ac, 47-to 420-Hz, source supply is applied through a 5-ampere circuit breaker mounted on the front panel (AC POWER ON/RESET), a surge suppressor (lightning arrestor), and a current limiter circuit, to a full-wave bridge rectifier, CR1 and CR4. The current limiter circuit is bypassed by relay contacts once the inverters are operating and 26v dc supply is available. The output of the rectifier is fed through a filter and a Zener diode to inverter starting relay K1. K1 produces a momentary bias surge (20 milliseconds) when the power supply is initially switched on. During the 20 milliseconds bias surge, the operation of both the 400-Hz and 5-kHz inverter circuits is initiated.

(1) The 400-Hz and the 5-kHz inverter circuits each consist of a multi-winding transformer and two switching transistors as part of an inverter-type power supply circuit. Each inverter circuit also contains spike suppressor base current limiters, switching speed-up diodes, and short circuit protection devices.

(2) The 400-Hz inverter transformer, T1, provides a 128v square wave at 400 Hz, to operate centrifugal fan 5A2B1. It also supplies a 26–0–26v square wave at 400 Hz, to alarm control 5TR1A3; the transformer's center tap is returned to ground through a resistor in the 5TR1A3 unit.

(3) The secondary winding of 5-kHz inverter transformer T2 is tapped to provide 5-kHz square wave outputs from which the 26v, 28v, 12v, 630v, and 7.2vdc outputs are derived.

(4) The 26v dc nonregulated supply is derived from a secondary winding of transformer T2, rectified and filtered before being fed to the output connector for distribution. The 26v dc supply also energizes relay K4, which in turn switches out input surge limiting resistor R48. Relay K4 contacts also close the 28v dc path through high voltage relay K2.

(5) The 28v and 12v dc regulated supplies are derived from a center-tapped winding of T2 (36v ac), rectified and filtered to provide 36v dc to the 28v regulator, and 18v dc to the 12v regulator circuit. A pre-regulator supply (44v ac) for the 28v and 12v regulators is taken across another center tapped winding of T2. The pre-regulator circuits increase regulation efficiency by providing a second feedback control voltage in parallel with the amplified feedback signal of the output voltage. Most of the transistors throughout the transmitter operate from the 12v dc supply, while high power transistors require 28v dc regulated supply. 28v dc is also fed through relay K4 contacts to relay K2 and is grounded through the **HV interlock circuit** in the transmitter rf head. When K2 is energized, the 200v ac appearing across the primary winding of T2 is connected to the primary winding of step-up transformer T3. The voltage developed across the secondary winding of T3 is rectified and filtered to produce the 630v dc plate supply for the power amplifier tubes.

(6) The two 7.2v filament (heater) supplies for the driver and output tubes of radiofrequency amplifier 6AR1 are derived from another wind-

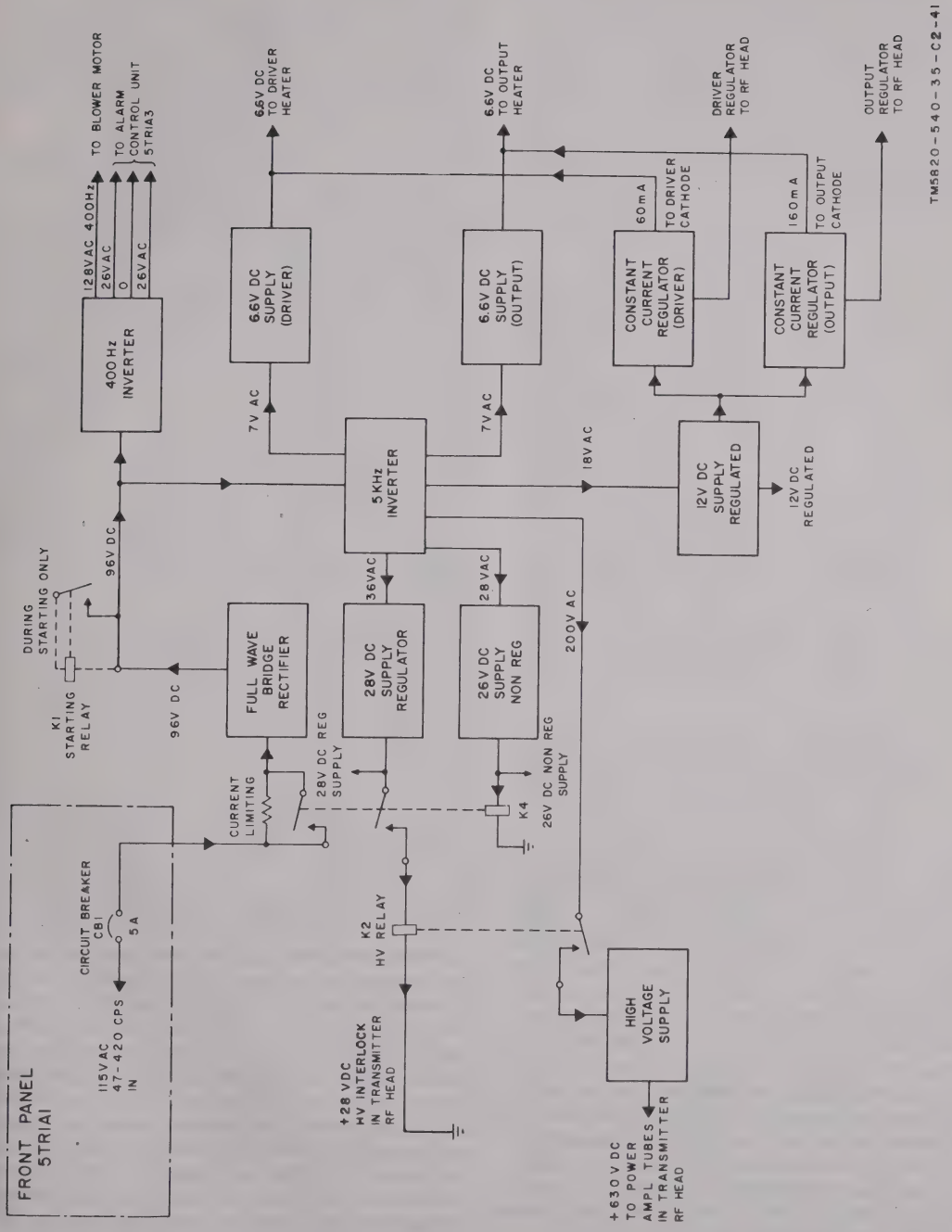

Figure 2-21. Power Supply 5TR1PS1, block diagram.

ing of T2. These voltages are separately rectified and filtered before being fed to the tubes.

(7) The two cathode current supplies to the power amplifier tubes are similarly derived from a T2 winding. The cathode current of the driver tube is regulated at 60 milliamperes, and the cathode current of the output tube is regulated at 160 milliamperes, to extend tube life. These current regulating circuits are returned to ground, through variable resistors mounted in the transmitter rf head. The variable resistors are used to set the currents to their nominal values.

c. Detailed Circuit Analysis (fig. 6–13).

(1) *Input circuit* (fig. 2–22). The 115-volt ac, 47-to 420-Hz source is fed through a 5 amp circuit breaker (AC POWER ON/RESET), mounted on the front panel of the transmitter fixed head, to contacts 6 and 7 of P1 of 5TR1PS1. The 115v supply is then fed through filters FL3, FL4, lightning arrestor E51, and current limiting resistor R48 (in power supply subassembly 5TR1PS1A2) to full-wave bridge rectifier CR1–CR4. The current limiting resistor R48 is bypassed by contacts A2 and A3 of relay K4, once the power supply is operating normally. Relay K4 is energized by the 26v unregulated supply. The output of the bridge rectifier (96v pulsed dc) is then fed through filter L1 and C1 to relay K1 which is part of the starting circuit, with Zener diode CR5 providing over-voltage protection.

(2) *Starting circuit* (fig. 2–22). Starting relay K1, when initially energized (power supply just switched on), applies a start pulse to both inverter circuits simultaneously. A momentary forward bias is applied to the bases of all four inverter transistors, Q1, and Q2 (400 Hz inverter) to insure a positive start of oscillations. Charging current in C18 flows through the relay K1 coil to energize it. The time constant of C18 and R4 is such that relay K1 remains energized for approximately 20 milliseconds. The start pulse is then applied through K1 contacts A2 and A3, and R6 and R9 to the base windings of inverter transformers T1 and T2 respectively. K2 **is the HV supply interlock circuit. 28-volt dc regulated is applied to one side of K2 coil through K4 contacts B1 and B2; the other side of the coil is connected to ground through the HV interlock circuit in the transmitter rf head. K2 contacts B1 and B2 apply the 200v from 5-kHz inverter transformer T2 to the input of high-voltage transformer T3.**

(3) *400 Hz inverter circuit* (fig. 2–23). Basically the inverter consists of two switching transistors and a transformer having a square hysteresis loop, the size and the shape of the hysteresis loop determining the oscillation frequency and output voltage waveform. Base input windings on the primary side of the transformer provide the feedback while the main primary winding provides the collector load.

The operation of both the 400-Hz and 5-kHz inverter circuits is identical; only the 400-Hz one will be described in detail. When voltage is applied to the circuit, 96v dc appears between terminal 5 of inverter transformer T1 and the emitters of Q1 and Q2 through resistor R5. Bias voltage is momentarily applied to Q1 and Q2 bases from pin 16 of transformer T1. When switching is initiated, voltages appearing at pins 15 and 17 of T1 are of opposite polarity, thus at any one time, the base of one transistor will be forward biased while the other will be reverse biased. Due to the forward bias, Q1 emitter-collector voltage will drop to about 1 volt. 96v is developed across winding 1–5 of T1 and by mutual inductance 96v series aiding is developed across winding 5–9 of T1; the resulting 192v will appear at the collector of Q2, which is cut-off due to the reverse bias on its base. These voltage conditions remain until transformer T1 saturates (a period of 1/500-second). As saturation is reached, the flux lines collapse, inducing voltages in the opposite direction in all windings. This causes a reversal of current and voltage relationships on Q1 and Q2; Q2 will conduct and Q1 will be cut-off. Since transformer T1 has a square hysteresis loop, the changeover in the direction of the voltage occurs very sharply and the resulting output voltage is an ac square wave whose frequency is 400 Hz. When Q1 and Q2 are switching, CR2 and CR3 conduct the out-of-phase current which results from the inductive load presented by centrifugal fan 5A2B1. CR1 and CR4 are speedup diodes passing the negative-going collector voltages to the base of the transistor which is being cut off. R1, R2, R7, and R8 limit the base drive in Q1 and Q2; C3 and R6 form a surge-limiting circuit providing a load during the Q1 and Q2 switchover. Resistor R5 provides short circuit protection. If the load current on either of the two output lines becomes excessive, a higher than normal collector current will flow through the conducting transistor, causing a high voltage drop across R5. This will bias off both transistors, shutting down the inverter. The inverter cannot start again until the power supply has been

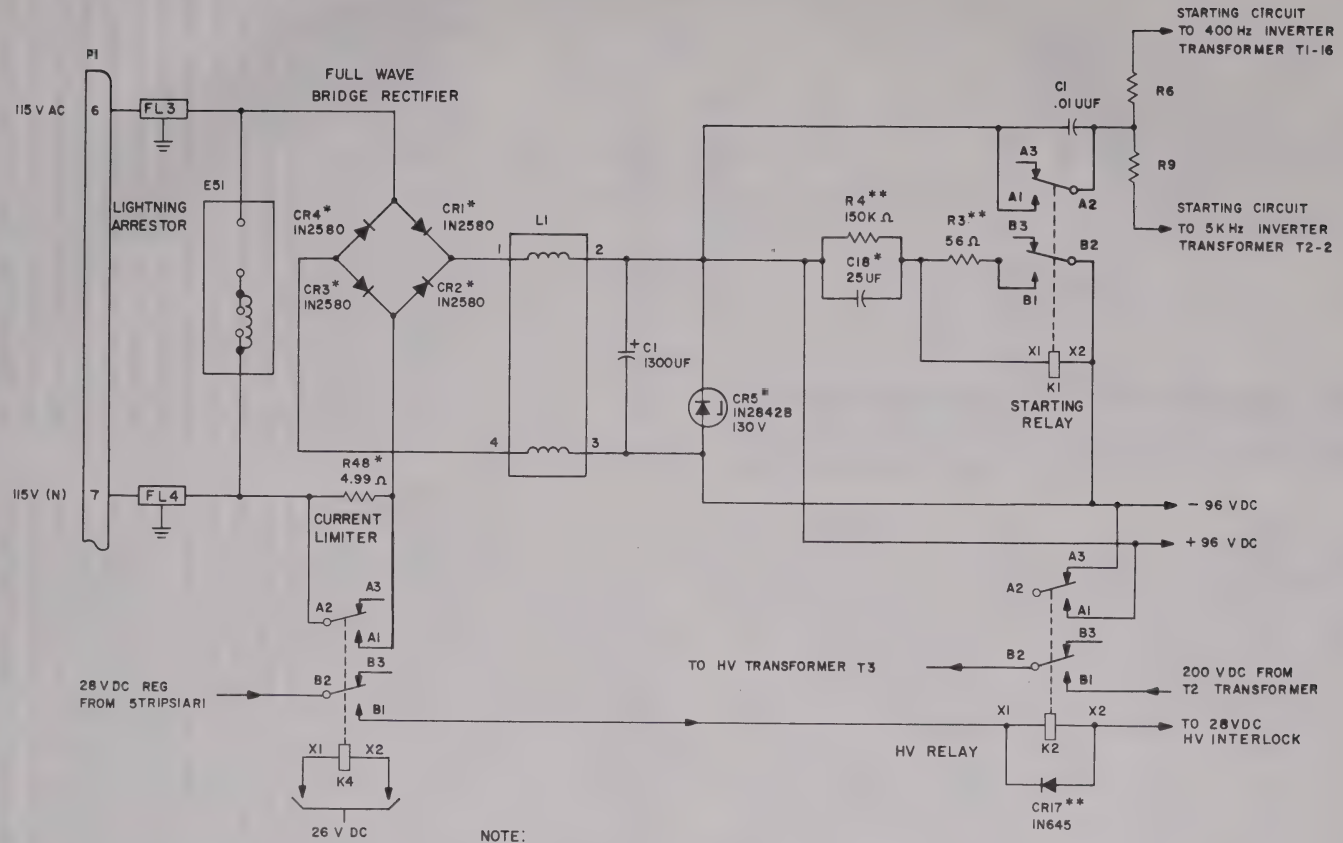

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Figure 2-22. Power supply, output and starting circuits, simplified schematic.

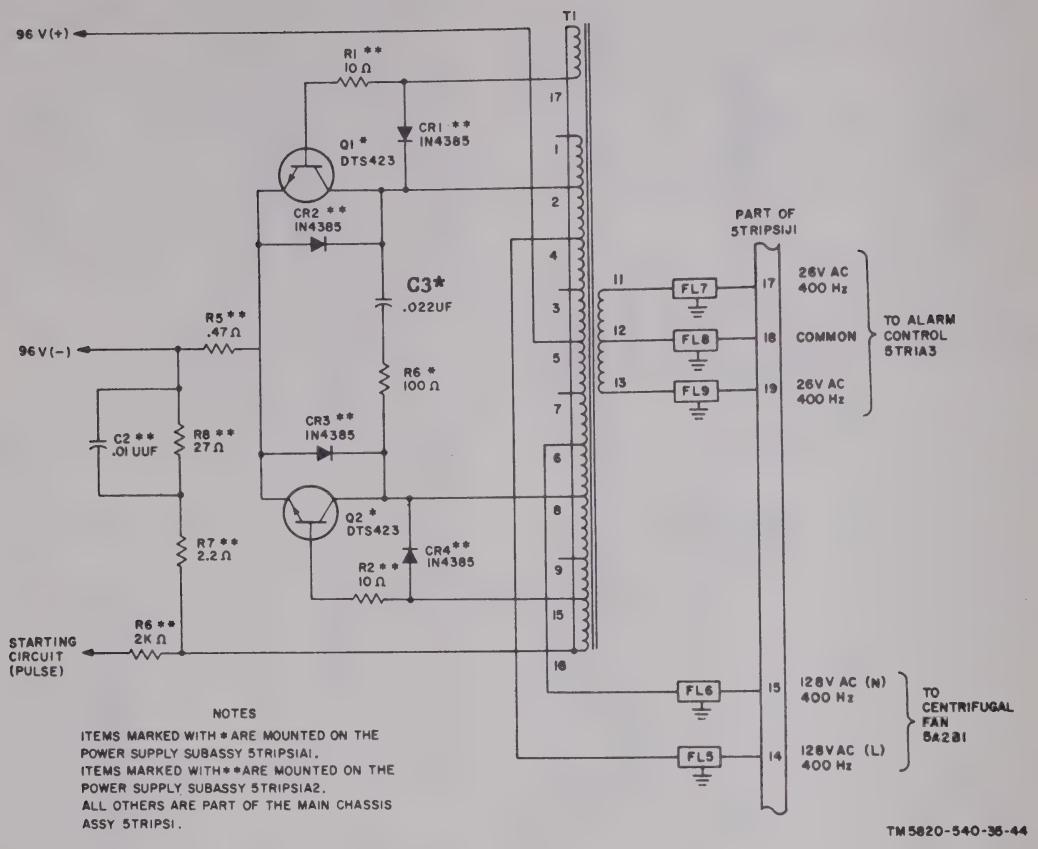

Figure 2-23. Power supply, 400 Hz inverter circuit, simplified schematic.

turned off and then back on because it requires a start pulse to initiate the switching action. C2 helps to speed up the switching action by effectively shorting out R8 during switch-over. The 128v ac, 400-Hz square wave for centrifugal fan operation is taken from terminals 4 and 6 of transformer T1, and fed through filter connectors FL5 and FL6 to the centrifugal fan. 26–0–26v ac for LOW POWER alarm operation is taken from secondary winding 11, 12, and 13 of T1 and fed through filter connectors FL7, FL8, and FL9 to alarm control 5TR1A3.

(4) *5 kHz inverter circuit* (fig. 2–24). The 5-kHz inverter circuit consists of switching transistors Q3 and Q4. A 96v dc starting pulse is applied through R9 to pin 4 of inverter transformer T2. The operation of the 5-kHz inverter is identical to the operation of the 400-Hz inverter except that it requires additional protective components due to its greater load and higher fre quency. Choke L2 speeds up the switching of th transistors. CR14 provides an additional protec tion against current flowing in the reverse direc tion through transistor Q3 or Q4. Zener diode CR8 and CR9 limit the transient voltage spike appearing at the collector of the cut off transis tor. CR7 and CR10 direct the current throug Zener diodes CR8 and CR9. CR6 and CR1 with CR5 and CR12, are also used to speed u switching in order to minimize heat dissipatio R12, a 0.332-ohm resistor, provides shortcircu protection. If the load current on the 600v lin becomes excessive, a higher than normal curre will flow through the conducting transistor, caus ing a high voltage drop across R12. This wi bias both Q5 and Q4, shutting down the inve ter. The inverter cannot start again until th power supply has been turned off and back o

again. A 200v ac, 5-kHz square wave output is taken from across the primary winding 1—3 of inverter transformer T2 and fed through relay K2 contacts B1–B2 to the primary winding of high voltage (hv) step-up transformer T3. Voltage taken from across secondary windings 13—14 is rectified in CR26, smoothed by C20 (15 uf), and filtered by L1 and C4, to produce the 26v dc unregulated supply for alarms, relays, and indicator lamp operation. 26v dc is fed directly to the relay K4 coil; K4 contacts close to bypass surge limiting resistor R48, when the power supply is operating normally (fig. 2–22). 26v dc unregulated is also fed through filters FL16 and FL17 to P1 pins 4 and 5 for distribution. Two separate 16v ac peak, center-tapped, 5 kHz square wave outputs are taken across windings 7, 8, 9, and 10, 11, 12 of transformer T2 and fed into power supply 5TR1PS1PS1 ((5) below). The 36v ac, 5-kHz square wave output taken from pins 15, 16, and 17 of T2 is fed into full wave rectifier CR16 and supplies 36v and 18v to the 28v and 12v regulator circuits in voltage regulator amplifier 5TR1PS1AR1. A 44v ac output voltage taken across pins 18, 19, and 20 is rectified and is then used as the pre-regulator supply for the 28v dc regulated supply.

(5) *6v dc power supply.* The 16v ac peak voltage across pins 7, 8, and 9 of transformer T2, center-tapped, is connected to terminals E1, E3, and E2 respectively (fig. 2–25) of power supply 5TR1PS1PS1 where it is rectified by CR1 and CR2; the dc voltage obtained is smoothed by C1, and fed through current limiting resistor R1 to one side of dual filter FL29 for further filtering. The 6.6v at the output of FL29 is then fed through filters FL22 and FL23 and P1 pins 20 and 21 respectively as filament voltage to the driver tube of radio frequency amplifier 6AR1. Similarly, the 16v ac peak voltage across pins 10, 11, and 12 of transformer T2 is rectified by CR3 and CR4, smoothed by C2, current limited by R2, filtered by FL29, and fed through FL20 and FL21 and P1, pins 22 and 23, to the output tube of radio frequency amplifier 6AR1 as filament voltage.

(6) *28v dc and 12v dc regulator circuits* (fig. 2–26). The 30v, 5-kHz square wave output across pins 15–17 (fig. 2–24) is rectified by CR16, smoothed by C19, filtered by L4 and C9, and applied simultaneously to the collectors of Q5 and Q6 (fig. 2–26). A reference voltage of 12.4v is taken across Zeners CR7 and CR8 to the base of Q4. The reference voltage in the base circuit of Q4 is reflected in the Q2 emitter circuit by emitter-follower action to provide base-emitter temperature compensation for Q2. A sample of the 28v output voltage, taken through voltage divider R9, R10, R11 is fed to the base of Q2 and provides the feedback voltage; Q2 and Q4 being in effect a differential dc amplifier circuit, the Q2 collector current is a function of the difference between the output voltage and the reference voltage. A decrease in the difference between the two voltages will cause a decrease in the Q2 collector current which in turn will cause an increase in the base current into Q6 and decrease the voltages across Q5 to maintain a constant output voltage.

A 44v, 5-kHz square wave output across pins 18, 19 and 20, is fed to rectifiers CR1 and CR2 (fig. 2–26). The 44v dc obtained is filtered by C1 and R4, and clamped 6.2v above the 28v regulated output voltage by Zener diode CR4. This *pre-regulator* voltage is fed through R6 to the base of Q6, effectively adding a second feedback line in parallel with the amplified feedback to increase regulator efficiency. R1 and CR5 provide shortcircuit protection, a reduction in load resistance causing an increase in the current in the 28v dc regulator, and an increase in the voltage drop across resistor R1. If the load resistance decreases beyond a critical value, Zener diode CR5 (4.3v) will fire and drop the voltage at the base of Q6, holding Q6 and Q5 at a constant series current of about 2.2 amperes. Removing the short condition, the circuit reverts again to a constant voltage regulator. The operation of the 12v dc regulator circuit is identical to the operation of the 28v dc regulator. An 18v, 5-kHz square wave input to the 12v regulator is taken from the center tap of the 15–16–17 winding of inverter transformer T2. The 6.2v reference voltage is taken across Zener CR8 (in the 28v dc regulator) and fed to the base of Q5; a sample of the output voltage is taken through voltage divider R12, R13, and R14 and fed to the base of Q3. The pre-regulator voltage is derived from the 28 vdc regulator circuit and fed to the base of Q1 through R5. Metering voltage for the 28v dc regulated supply is derived through voltage divider R16, R17, and R18. R17 is a meter calibration potentiometer and is calibrated to give midscale indication at +28v dc. Similarly, voltage for the 12v dc regulated supply is obtained through voltage divider R19, R20, and R21. The meter common line for the 12v and 28v supplies is taken across Zener diode CR9 to provide an expanded scale on the meter.

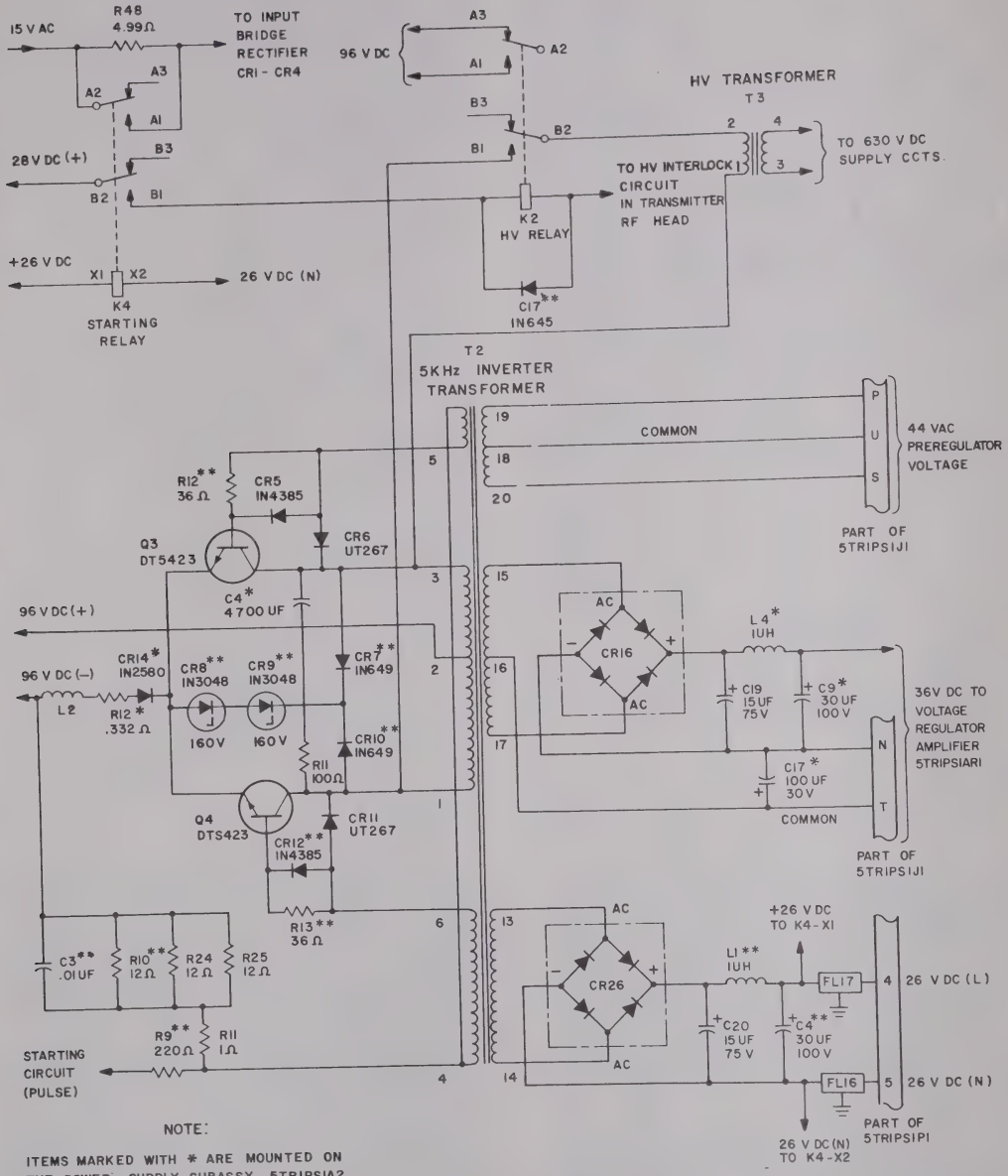

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Figure 2-24. Power supply, 5-kHz inverter circuit, simplified schematic.

(7) High voltage (620v) power supply (fig. 2-27). A 200v, 5-kHz square wave output, taken across pins 1 and 3 of inverter transformer T2, is fed to contact B2 of relay K2. 28v dc to the

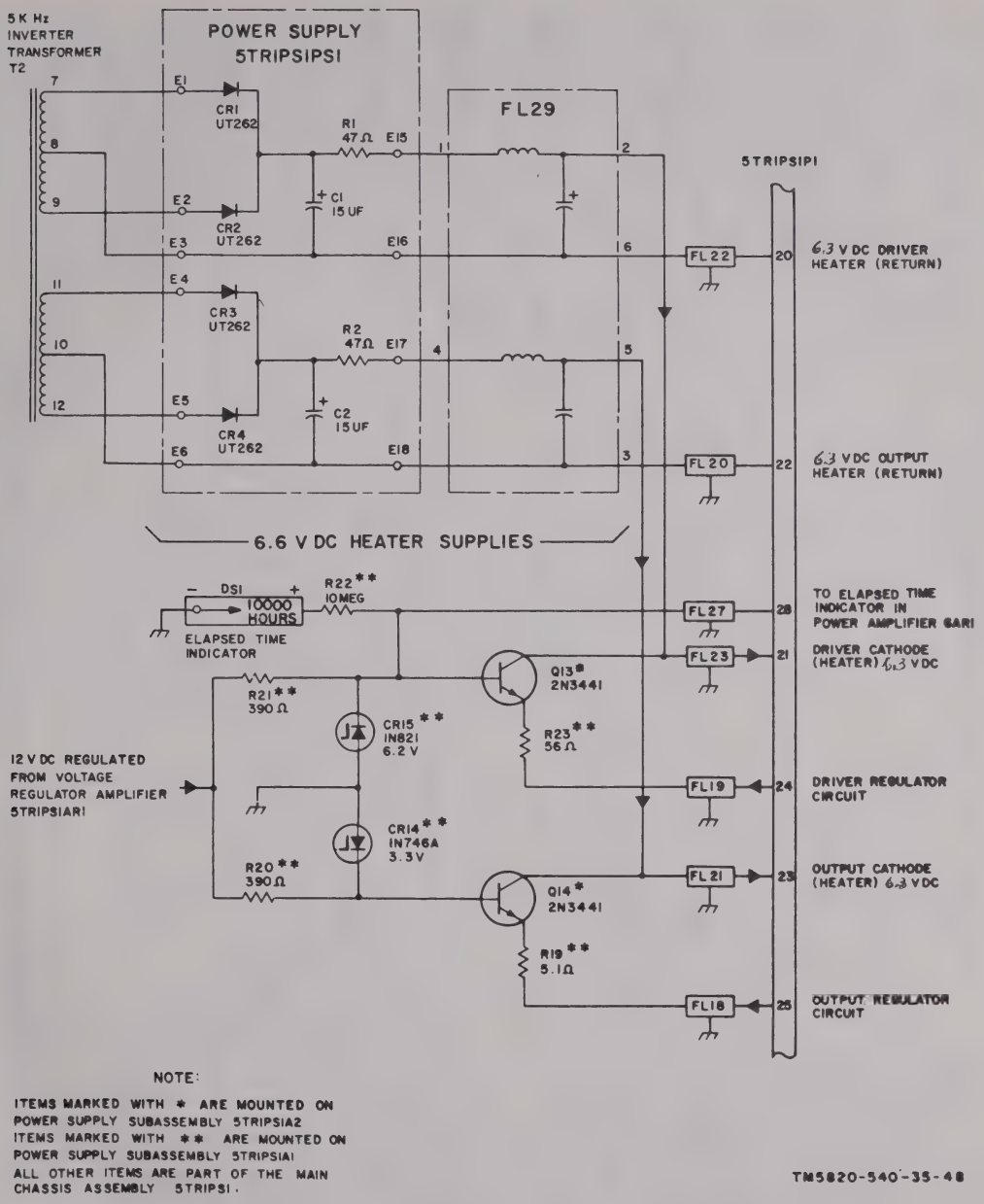


Figure 2-25. Power supply, 6.6v dc heater and constant current supplies, simplified schematic

coil of relay K2 is taken from the voltage regulator amplifier and applied through P1–J1 pin C and contacts B1 and B2 of starting relay K4 (energized by 26v), to the coil of relay K2. The return path of the 28v dc is through FL25 and P1-26 to the HV interlock circuit in the transmitter rf head and back through P1-33 to the 28v dc common point at terminal 2 of FL28. When K2 is energized, the 200v, 5-kHz square wave is applied through contacts B2 and B3 to the to the pri-

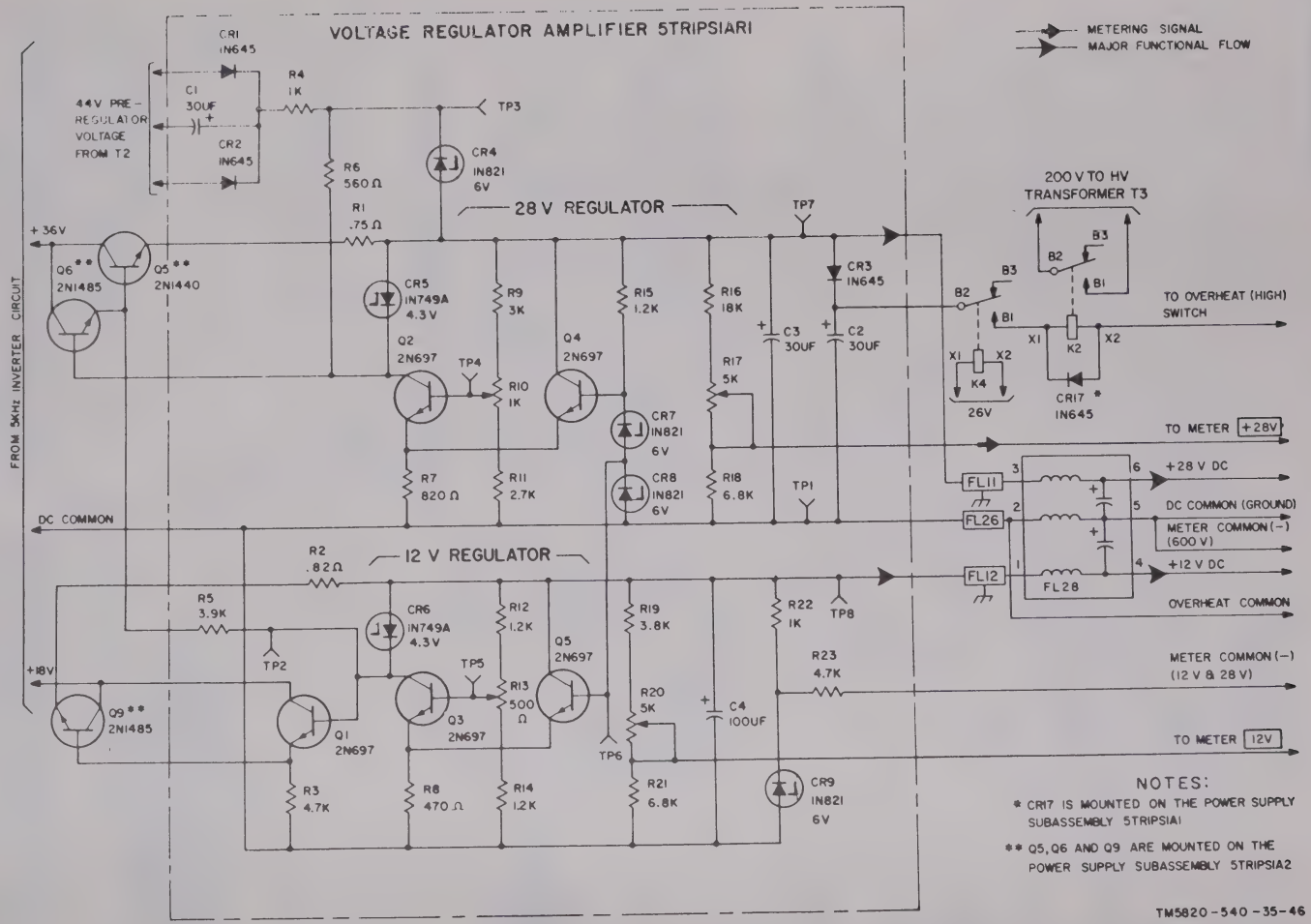


Figure 2-26. Power supply, regulated 12-volt and 28-volt dc supplies. simplified schematic.

mary winding of step-up transformer T3, of approximately 3:1 voltage ratio. The voltage across the secondary winding of T3 is rectified by CR15 and filtered by C6, L2. +630v dc is then made available through P1-A1 to the two power amplifier tubes in the transmitter rf head. The 630v dc line through voltage divider R16, R15, R17, and R18 is fed to the meter through Zener diode CR13 and R14. The meter is calibrated for midscale indication at 630v; the meter is on an expanded scale and a 10 percent change in the meter reading represents a 30v change in the high voltage supply.

(8) *Constant current supplies* (fig. 2-25). Two constant current circuits regulate the cathode current of the driver amplifier tube at 60 ma maximum and that of the output tube at 160 ma maximum. 12v dc regulated voltage from the 12v dc regulator (J1 pin J) is fed into power supply subassembly 5TR1PS1A2 through E30 and applied simultaneously to the bases of two high voltage transistors, Q13 and Q14, through R21 and R20. The 6.2v Zener diode CR15 and the emitter resistance keep the base current to Q13 basically constant. The collector of Q13 is connected to the driver amplifier cathode through FL23 and P1-21; the emitter is returned to ground through R23, FL19, P1-24, and a variable resistor (R1) in the transmitter rf head (para 2-26). The value of R23 is chosen to provide the proper nominal value of cathode current; variable resistor R1 in the transmitter rf head is used for fine current adjustment. Similarly, 3.3v Zener diode CR14 and the emitter resistance keep the base current of Q14 constant. The collector of Q14 is connected to the output amplifier cathode through FL21 and P1-23; the emitter is returned to ground through R19, FL18, P1-25, and variable resistor R2 in the transmitter rf head.

(9) *Elapsed time indicator supply.* The elapsed time indicator in the power supply is fed a constant current of about 6 microamperes derived from CR15 and R22. The voltage at Zener CR15 is also fed through FL27 and P1-28 to the elasped time indicator in circuit card assembly 6AR1A2A2 in the transmitter rf head (para 2-26).

2-19. Transmitter Metering Circuits

a. General. The transmitter metering circuits include a 100-microampere meter which is connected into the various metering circuits by a 12-position rotary selector switch. The transmitter metering circuits indicate power and voltage levels throughout the transmitter fixed and rf heads. The meter has a 0-to-100 scale with a green band in the center. For any selector switch position marked with a green dot, a normal reading should fall within the green band. Each metering circuit has its own meter-matching circuit and a calibra-

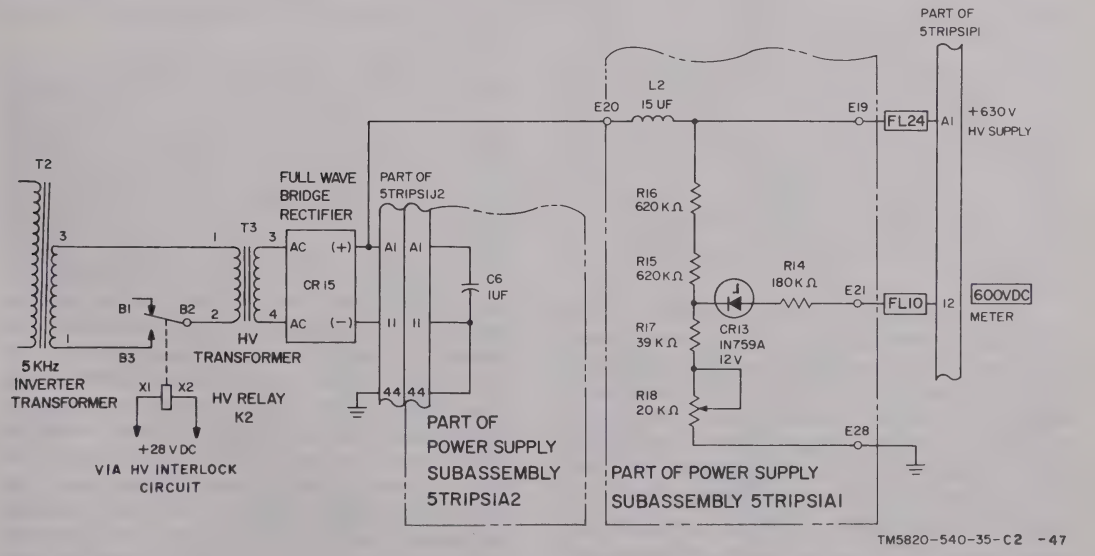


Figure 2-27. Power supply, 630-volt dc supply, simplified schematic diagram.

tion resistor so that the one meter can serve to indicate various power and voltage ranges. The following chart lists the metering circuits of the transmitter and their normal indications.

Switch position	Normal value	Scale reading (percent fullscale deflection)
OSC	25 milliwatts	50
DOUBLER	3 watts	50
MULT	600 milliwatts	30-40
DRIVER	3 watts	20-60
PWR OUT	25 watts	70
REFL PWR	Zero power	Less than 20
12 CH PCM	180 kHz peak*	50
24 CH PCM	300 kHz peak*	50
FDM	75 kHz peak*	50
12v	12v dc	50
28v	28v dc	50
600v	630v dc	50
	*Transmitter deviation	

b. Metering Circuits Analysis (fig. 2–28). For point-to-point tracing of metering circuits refer to figure 6–14.

(1) *OSC metering (position 1).* The OSC meter position gives an indication of the electrical frequency synthesizer 5TR1A2 output signal as it is fed into amplifier-frequency multiplier 5TR1A4. A portion of the rf signal at the output of modulator-oscillator 5TR1A2A2 (para 2–4) is rectified by CR4 to produce a dc metering signal proportional to the rf signal. The dc signal is then fed through R20 and FL1, through interconnecting box 5TR1A2A1 in the synthesizer, to monitor panel 5TR1A1 and meter selector switch S1–A (meter positive). The meter return is grounded at interconnecting box 5TR1A2A1. A 50 percent of full scale reading on the meter is equivalent to approximately 25 milliwatts rf output. 40 to 60 percent fullscale deflection represents approximate synthesizer outputs from 15 to 40 milliwatts.

(2) *DOUBLER metering (position 2).* The DOUBLER metering signal is derived from the rf output of amplifier-frequency multiplier 5TR1A4 (para 2–16) which is used to drive frequency multiplier assembly 6A2. The signal is derived from the voltage drop across L15 in the Q3 collector circuit, R4, filtered by C35 and FL1, and fed through interconnecting box 5TR-1A2A1 to panel monitor 5TR1A1 and meter selector switch S1–A (meter positive). The metering return line is fed through the interconnecting box to amplifier-frequency multiplier 5TR1A4 and is decoupled by C34, R17, and L17. The meter circuit has been calibrated to give a 50 percent of full scale reading for a nominal 3-watt output signal. 40 to 60 percent of full scale deflection represents approximately a 2-to 3.5-watt output signal.

(3) *MULT metering (position 3).* The MULT metering signal gives an indication of the multiplier drive signal (output of frequency multiplier assembly 6A2) fed into radio frequency amplifier 6AR1. A portion of the rf signal at the output of electronic switch 6A1 (para 2–23) is rectified by CR1 to produce a dc metering signal proportional to the rf signal. The dc voltage is fed through distribution box 5A2A1 to monitor panel 5TR1A1 and meter selector switch S1–A. Diode CR1 across the MULT metering circuit is used to limit the dc voltage fed into the meter. A 600-milliwatt output signal will provide 30 to 40 percent of full scale indication.

(4) *DRIVER metering (position 4).* The DRIVER meter position gives an indication of the rf output of the driver stage of radio frequency amplifier 6AR1, which is fed into the output stage (para 2–26). Variations in cathode voltage of the output tube, corresponding to changes in rf drive, are metered through resistor R4 of circuit card assembly 6AR1A2A2 and through the distribution box to monitor panel 5TR1A1 and meter selector switch. 3 to 8.5 volts on the output cathode provide a 20 to 60 percent of fullscale reading which corresponds to 2 to 3 watts drive.

(5) *PWR OUT metering (position 5).* The PWR OUT metering circuit measures forward (output) power at the output of the transmitter rf head (PWR OUT connector). A thermistor-controlled detector circuit in series with the forward power coupling probe produces a dc signal porportional to forward power going through power monitor 6AR1A3 (para 2–26). The dc signal is fed through the distribution box to the panel monitor and meter selector switch (meter positive). The meter common is returned to ground at the transmitter rf head through the distribution box. A 5,000-ohm resistor, R3, in the monitor panel is connected across the PWR OUT metering signal when the meter selector switch is set to every position except position 5. This is done to make sure that the monitor signal, which is also used to operate alarm control 5TR1A3, is not disturbed when switching the meter selector to other positions. A 100 percent of full scale meter reading indicates a 40-watt output, while a nominal 25

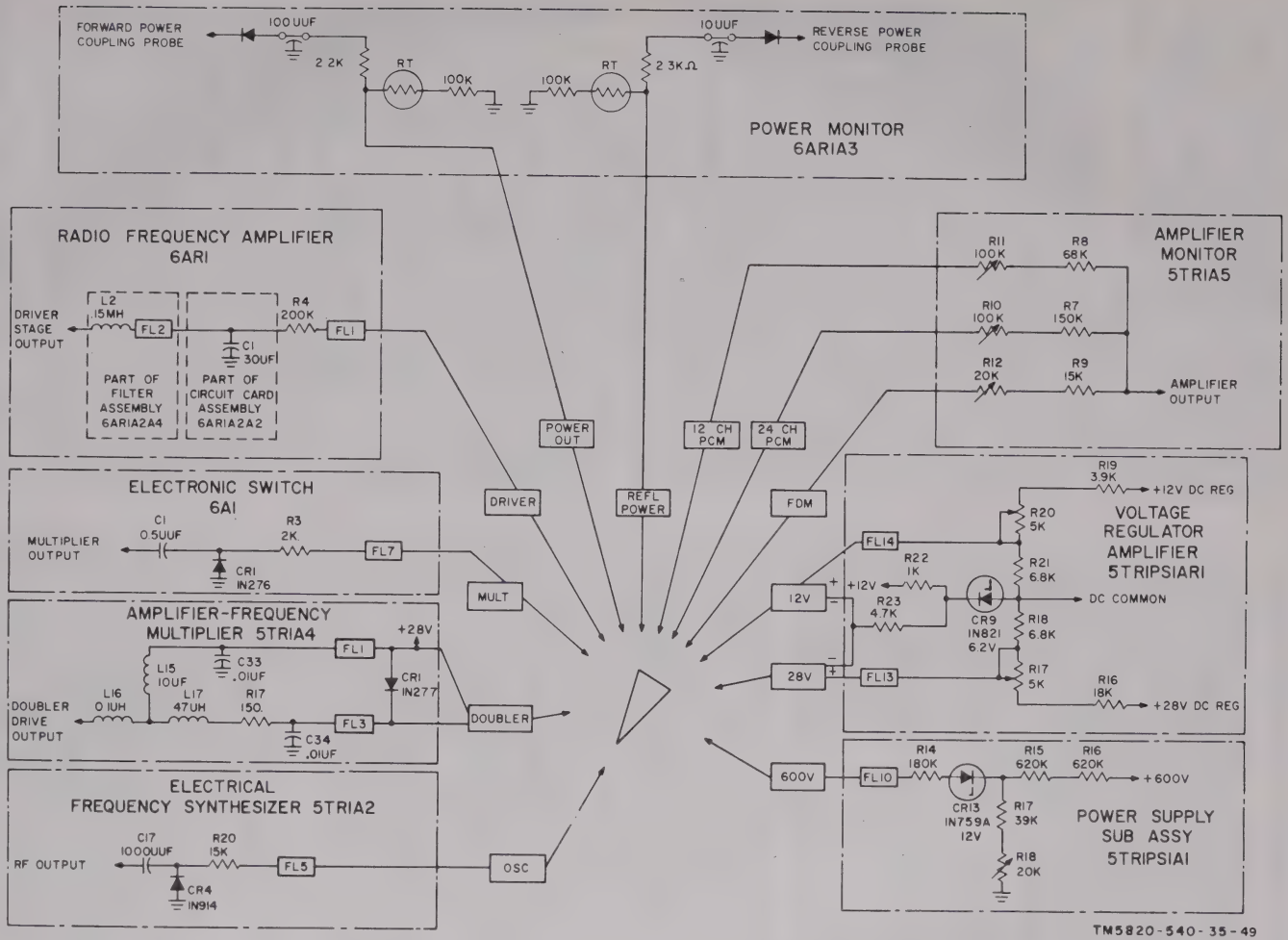


Figure 2-28. Transmitter metering circuits, simplified schematic diagram.

watt output will produce a 70 percent meter indication.

(6) *REFL POWER metering (position 6).* The REFL POWER metering gives an indication of reverse power at the output of the transmitter rf head. The rf signal from the reverse power coupling probe is detected, producing a dc signal proportional to reflected power through power monitor 6AR1A3. A thermistor connected across the detector circuit provides a constant output independent of temperature. The resulting dc signal is fed through distribution box 5A2A1 into monitor panel 5TR1A1 and meter selector switch S1–A (meter positive). The negative side of the meter returns through S1–B and the distribution box to the meter common point in the transmitter rf head. Normal indication is almost zero power (less than 10 percent of full scale deflection) although as much as 4 watts (approximately 20 percent of full scale) is acceptable.

(7) *12 CH PCM, 24 CH PCM, and FDM metering (positions 7, 8, and 9 respectively).* These metering circuits are derived from the modulation signal (combined baseband and order wire) before it is fed to electrical frequency synthesizer 5TR1A2. A portion of the composite signal from video monitor 5TR1A5A1 (para 2–2) is amplified, then rectified to produce the dc voltage for metering functions. This dc voltage is fed through separate meter calibration circuits (R8 and R11; R7 and R10; R9 and R12) directly into monitor panel 5TR1A1 selector switch S1–A. The meter return circuit is brought back into amplifier-monitor 5TR1A5 and connected to ground through 220-ohm resistor R5. Meter calibrating potentiometers R11, R10, and R12 are adjusted to indicate 50 percent of full scale deflection for the following transmitter deviations:

R11	12 CH PCM	180 kHz peak-to-peak
R10	24 CH PCM	300 kHz peak-to-peak
R12	FDM	75 kHz peak-to-peak

(8) *12v and 28v metering (positions 10 and 11 respectively).* The 12v and 28v metering voltages are derived from the corresponding outputs of voltage regulator amplifier AR1 of power supply 5TR1PS1 (para 2–18). Metering voltage for the 12-volt dc regulated supply is derived through the R19, R20, and R21 voltage divider; metering voltage for the 28 volts dc regulated supply is derived through the R16, R17, and R18 voltage divider. R20, METER CAL 12V, and R17, METER CAL 28V, adjust the 12-volt dc and 28-volt dc voltage dividers respectively for a 50 percent of full scale meter indication. The meter is on an expanded scale; a 10 percent meter variation represents 200 millivolts change in the 12-volt dc supply voltage, and 300 millivolts change in the 28-volt dc supply voltage. Both metering voltages are returned to the same meter common point in voltage regulator amplifier 5TR1PS1AR1, which is clamped by 6.2 volt Zener diode CR9.

(9) *600v metering (position 12).* The 600v metering circuit provides an indication for the 630-volt dc high-voltage supply to radio frequency amplifier 6AR1. The metering circuit is derived from the 630-volt dc line (para 2–18) through voltage divider R16. R15, R17, and R18. Voltage is adjusted by METER CAL control R20. CR13 and R14 expand the metering scale, so that zero deflection represents 200 volts and full-scale deflection represents 1,000 volts when metering the 630v supply. The metering circuit is calibrated to indicate 50 percent of full scale deflection for 630 volts dc. The 630-volt metering circuit is fed through distribution box 5A2A1 wiring to monitor panel 5TR1A1 and selector switch S1–A. The metering return point is in power supply 5TR1PS1.

2–20. Transmitter Alarm Circuits

a. General. The transmitter alarm circuits are part of the monitor panel (front panel of the transmitter fixed head) and work in conjunction with alarm circuits in the transmitter fixed head (electrical frequency synthesizer 5TR1A2, power supply 5TR1PS1, and alarm control 5TR1A3) and the transmitter rf head (radiofrequency amplifier 6AR1). Monitor panel 5TR1A1 includes an alarm control 5TR1A1A2, four indicator lights (AC POWER, SYNC, OVERHEAT, LOW POW9R), one buzzer, and three manually controlled switches (AC POW9R: ON/RESET–OFF, BUZZER OFF, and BUZZER OFF–ALARMS NORMAL). The buzzer sounds when a change of state occurs in the associated alarm circuits. A fault will cause the buzzer to sound. Pushing the BUZZER OFF switch silences the buzzer. Once all fault conditions are corrected, the buzzer will sound again until the BUZZER OFF switch is operated again. A built-in switch (BUZZER OFF-ALARMS NORMAL) enables the buzzer to be muted and the lamps dimmed during testing, alignment, and correction of fault conditions.

b. Indicator and Alarm Circuits Description (fig. 2–29). For point-to-point tracing of indicator and alarm circuits refer to figure 6–14.

(1) *Ac input circuit.* When ac power is switched on, +26 volts dc from power supply

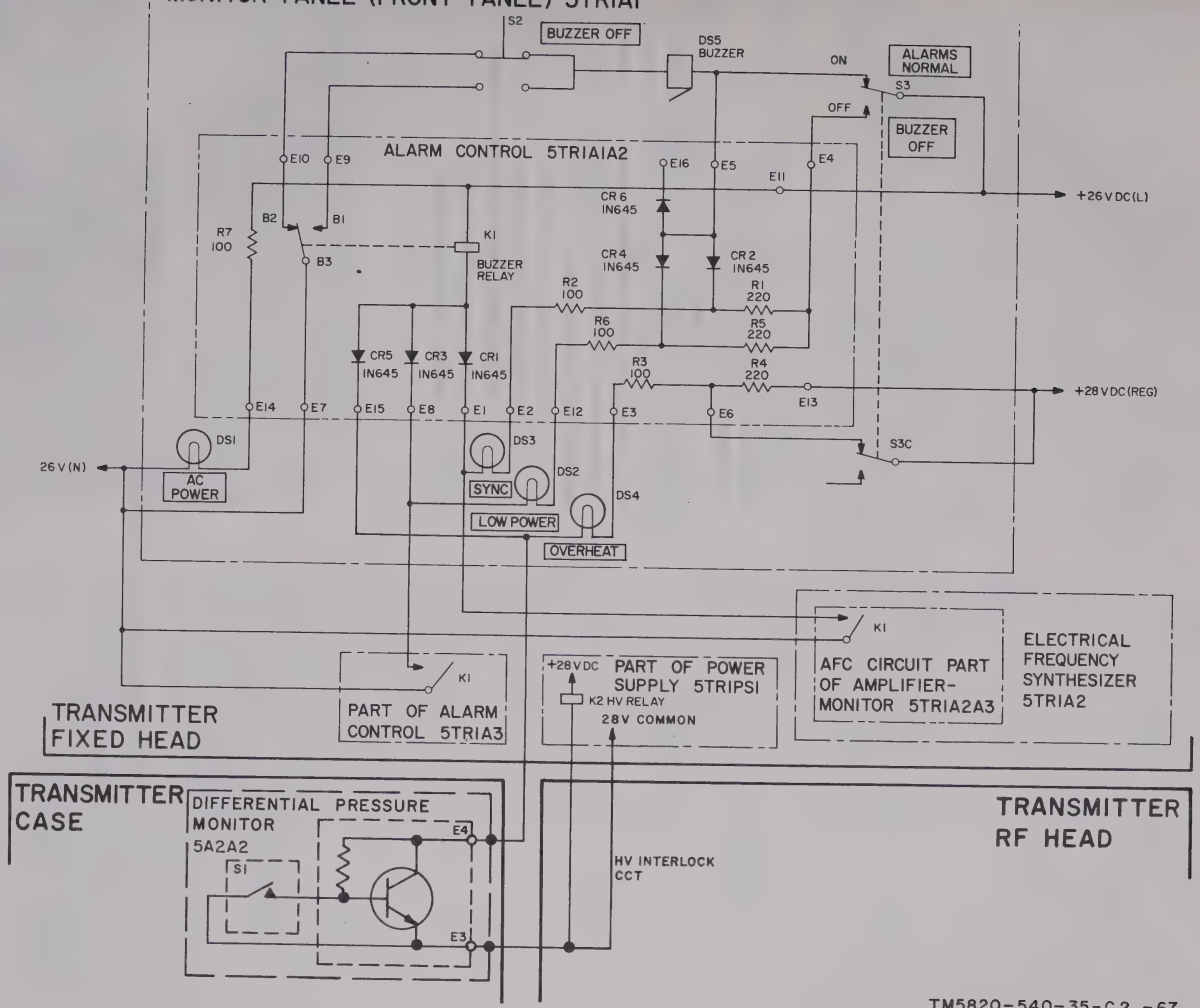


Figure 2-29. Transmitter alarm circuits, simplified schematic diagram.

5TR1PS1 is fed through J3–4 into monitor panel 5TR1A1 and through E11 of alarm control 5TR–1A1A2 to one side of buzzer control relay K1 and to the AC POWER indicator lamp DS1 (through R7 and E14). The 26v dc is returned through J3–5 to the power supply. 26 volts dc is also applied through the BUZZER OFF–ALARMS NORMAL switch (in the ALARMS NORMAL position) to one side of the buzzer. The dc path through the buzzer is closed through contacts of buzzer control relay K1. At the same time, regulated +28 volts dc from the power supply is fed into the monitor panel through J3–1 and made available through E13 to alarm control 5TR1A1A2.

(2) *SYNC (afc) alarm.* The SYNC alarm alarm circuit operates in conjunction with SYNC alarm relay K1 in amplifier-monitor 5TR1A2A3 (para 2–14) of electrical frequency synthesizer 5TR1A2. Normally the SYNC alarm relay is held operated by the afc SYNC alarm detector circuit and by the clock pulse D integrator. The SYNC alarm relay drops out when afc voltage is outside limits or when clock pulse D is absent. Operating range of the SYNC alarm relay (2.5 to 10-volts on the afc line) is established by Zener diode CR3 and potentiometer R3 and corresponds to the frequency control limits in the vco. When the afc voltage is outside these limits, the afc of the vco has been lost, and the SYNC alarm relay drops out. Normally, clock pulse D, fed into the integrator, holds control transistor Q4 operated and in turn relay control transistor Q5 at cut-off and the SYNC relay operating. In the absence of clock pulse D the relay drops out. When the relay is de-energized, the 26-volt dc path through SYNC indicator lamp DS3, buzzer control relay K1, and control diode CR1 in alarm control 5TR1A1A2 is closed. (The circuit passes through the monitor panel, through interconnecting box 5TR1A2A1 in the synthesizer to the amplifier-monitor board). The SYNC lamp illuminates and the buzzer sounds; the BUZZER OFF switch silences the buzzer while the alarm condition is being corrected. When normal operating conditions are restored, the SYNC alarm relay in the synthesizer is energized, and opens the 25-volt dc path. The SYNC indicator lamp is out, the buzzer relay drops out, but the buzzer sounds. Pushing the BUZZER OFF switch restores the buzzer circuits to normal.

(3) *LOW POWER alarm.* The LOW POWER alarm circuit operates in conjunction with alarm control 5TR1A3 (para 2–17) and is an indication that transmitter power output is below the minimum set level. When the transmitter output is 8 db below the normal output level, the dc amplifier in alarm control 5TR1A3 is cut-off, causing the LOW POWER alarm control relay to drop out and close the 26-volt dc path through LOW POWER indicator light DS2, buzzer control relay K1, and control diode CR3. The alarm circuit is connected directly to alarm control 5TR1A3. Operation of the LOW POWER alarm lamp and the buzzer circuit is the same as in the SYNC alarm circuit.

(4) *OVERHEAT alarm.* OVERHEAT alarm circuit operates in conjunction with pressure differential monitor 5A2A2, and is an indication of a failure in the air cooling system. If the centrifugal fan ceases to operate, or fails to move the required air volume, the difference of pressure between the ends of the sensor switch causes the switch contacts to open; this in turn causes the direct current amplifier to operate and provide a return path for the +28v dc through DS4, and for the +26v dc through the coil of buzzer control K1.

(5) *BUZZER OFF—ALARMS NORMAL switch.* In the BUZZER OFF position, this switch removes the +26-volt dc supply from the buzzer circuit and connects 220-ohm dimming resistors R1, R4, and R5 in series with the SYNC, OVERHEAT, and LOW POWER indicator lamps respectively.

Section II. AMPLIFIER-FREQUENCY MULTIPLIER AM–4320/GRC–103(V)

2–21. Functional Block Diagram Analysis of Amplifier-Frequency Multiplier AM–4320/GRC–103(V) (fig. 2–30)

The rf output of amplifier-frequency multiplier 5TR1A4 is fed into Amplifier-Frequency Multiplier AM–4320/GRC–103(V) (transmitter rf head) where it is multiplied and amplified to produce the final transmitter frequency.

a. The transmitter rf head multiplication circuits provide the final multiplication required to produce the selected transmitter channel frequency. The multiplication circuits are made up of electronic switch 6A1 and frequency multiplier assembly 6A2. The electronic switch is a double-pole, double-throw rf switch which routes the rf signal to and from the times-2 or times-3 circuits of the frequency multiplier assembly. Electronic switch 6A1 is programmed by control line 13 from

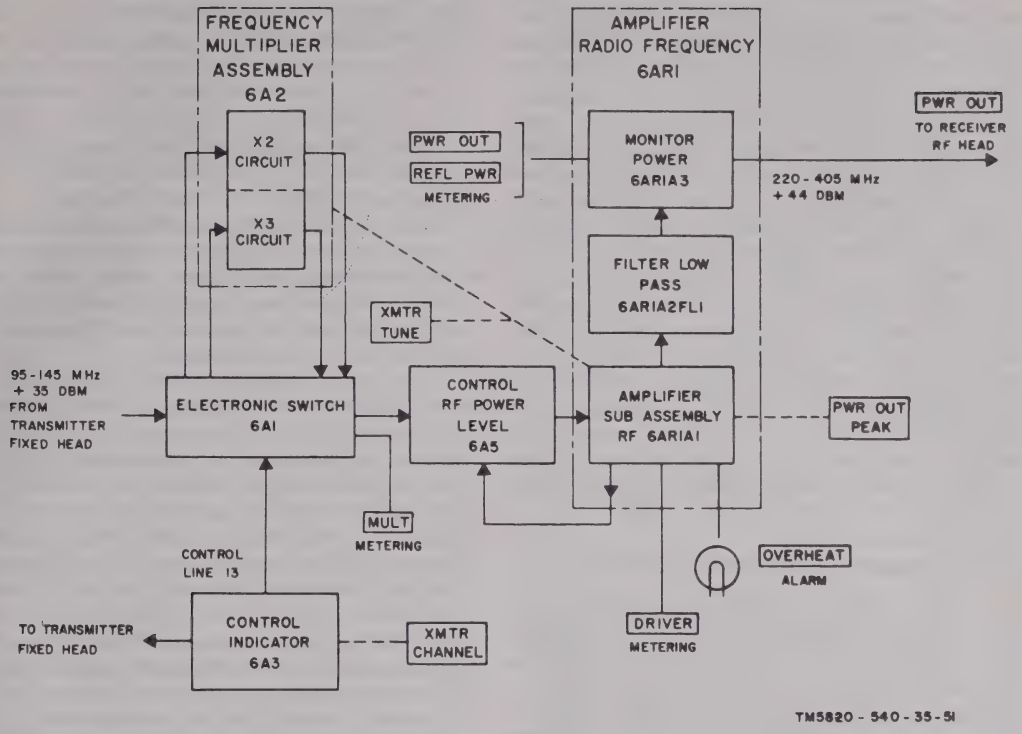


Figure 2-30. Transmitter rf head, block diagram.

control-indicator 6A3. Frequency multiplier assembly 6A2 contains two separate varactor multiplier circuits, one acting as a frequency doubler, the other as a frequency tripler. The output harmonic frequency of the frequency multiplier assembly is selected in a tuned circuit which is ganged to the front panel XMTR TUNE control. The output frequency in the range of 220 to 405 MHz is then fed back into the electronic switch, which routes the signal through rf power level control 6A5 and filter assembly 6AR1A2A4 to the first stage (driver) of radio frequency amplifier 6AR1.

b. The amplification of the output signal to the final output level is done in two-stage radio frequency amplifier 6AR1 (driver and output power amplifier), using two planar triodes type 7211 mounted within tuned quarter-wave resonant cavities. Tuning of the driver and output cavities is manually accomplished by the XMTR TUNE control on the transmitter rf head front panel; power peaking is accomplished by the PWR OUT PEAK control.

Rf power level control 6A5 controls the rf power fed into the driver stage of the radio frequency amplifier to prevent the output stage from operating at an excessively high rf level.

c. Radio frequency amplifier 6AR1 amplifies the final frequency of the transmitter to a level of approximately 30 watts. After rejection of harmonics in low pass filter 6AR1A2FL1, the output signal is delivered through power monitor 6AR1A3 and the PWR OUT connector to Amplifier-Converter AM-4316/GRC-103(V) (receiver rf head) and through a duplexer, to the antenna system. A sample of the output power taken by power monitor 6AR1A3 is rectified and supplied to alarm control 5TR1A3 which provides a warning when the rf signal power falls about 8 db below the nominal output level.

d. Control-indicator 6A3 (channel selector) is an electro-mechanical device operating in conjunction with electrical frequency synthesizer 5TR1A2 and amplifier-monitor 5TR1A5 in the transmitter fixed head, and with the frequency multiplication circuits in the transmitter rf head. The channel selector provides 13 control lines, but only 11 are used in this configuration, lines 1 and 2 being left open. Lines 3 to 13 inclusive program the frequency generating circuits in the electrical frequency synthesizer. Line 13 is also associated with the times-2 or times-3 multiplication factor changeover, thus controlling the variable attenuators in amplifier-monitor 5TR1A5 and the changeover switching in electronic switch 6A1. Channel selection is achieved manually by the XMTR CHANNEL control; a decade counter ganged to the XMTR CHANNEL control provides a visual indication of the selected channel.

e. An overall schematic diagram of the transmitter rf head is shown in fig. 6–15.

2–22. Frequency Multiplication Circuits

a. General. The frequency multiplication circuits consist of electronic switch 6A1 and frequency multiplier assembly 6A2. They provide the final frequency multiplication required to produce the selected transmitter channel frequency. Frequency multiplier assembly 6A2 contains two separate varactor multiplier circuits; a doubler and a tripler. Switchover from times-2 to times-3 multiplication is accomplished by electronic switch 6A1, which is a double-pole double-throw rf switch operated by changing bias voltages on PIN diodes.

b. Block Diagram Analysis (fig. 2–30). The output of amplifier frequency multiplier 5TR1A4 in the range of 95 to 145 MHz at a level of +35 dbm ±1 db (3 watts) is fed into the input connector of electronic switch 6A1. For a selected transmitter channel below channel 180 the rf signal is directed to the times-2 multiplier circuits of frequency multiplier assembly 6A2. The output of the times-2 multiplier is then fed through the electronic switch to rf power level control 6A5. Similarly, when the selected channel is 180 and above, the rf signal is directed through the electronic switch to the times-3 multiplier circuits, back into the electronic switch and out to rf power level control 6A5. The rf signal after frequency multiplication is at the selected transmitter channel frequency in the range of 220 to 405 MHz at a level of +29 dbm (800 milliwatts) ±2 db.

2–23. Electronic Switch 6A1

a. General. The electronic switch is a double-pole double-throw rf switch controlled by changing the biases on PIN diodes in the two rf paths. Line 13 of control-indicator 6A3 is grounded below channel 180, and has 26 volts dc on it at channel 180 and above. This ground on line 13 causes relay K1 of the electronic switch to energize and apply a forward bias on two PIN diodes in series with the times-2 multiplier circuits (input and output paths) and a reverse bias on the corresponding diodes in the times-3 multiplier circuits. When line 13 is carrying 26 volts dc the relay drops out, reversing the polarity of the bias on the PIN diodes.

b. Detailed Circuit Analysis (fig. 6–16).

(1) *Times-2 operation, channels 40 to 179 inclusive.* Line 13 from control-indicator 6A3 arriving at 6A1P2 pin 6 is grounded at 6A3. 26v dc is available at all times at 6A1P2 pin 7 and is applied through CR6 to the coil of relay K1, energizing it. 26V dc at 6A1P2 pin 1 is applied through K1 contacts B1 and B2 to the cathode of PIN diode CR3 through FL4 and L3, and to the anode of PIN diode CR4 through FL3 and L2. CR3 is forward biased while CR4 is reverse biased. 26v dc at 6A1P2 pin 3 is applied through K1 contacts A1 and A2 to the cathode of CR5 through FL6 and L4, and to the anode of CR2 through FL1 and L1. CR5 is reverse biased while CR2 is forward biased. Dc common for the two pairs of diodes is provided through R1, FL2, FL5, and R2. The incoming rf signal (110 to 144.75 MHz) at 6A1J5 is therefore routed through C3, CR2, C2, and 6A1J4 to 6A2P1, the input connector of the times-2 multiplier circuits. The output of the times-2 multiplier circuit (220 to 289.5 MHz) at 6A2P2 is then routed through 6A1J3, C5, CR3, and C6 to output connector 6A1J6.

(2) *Times-3 operation, channels 180 to 410 inclusive.* Control line 13 from the control-indicator carries 26v dc and K1 relay is deenergized. 26v dc at 6A1P2 pin 3 is applied through B3 and B2 to the cathode of CR3 (reverse bias) and to the anode of CR4 (forward bias). 26v dc at 6A1P2 pin 1 is applied through K1 contacts A3 and A2 to the cathode of CR5 (forward biased) and to the anode of CR2 (reverse bias). The incoming rf signal at 6A1J5 is routed through C3, CR4, C4 and 6A1J2 to 6A2P3, the input connector of the times-3 multiplier circuits. The output of the times-3 multiplier circuit (290 to 405 MHz) at 6A2P4 is then routed through 6A1J1, C7, CR5, and C6 to output connector 6A1J6.

(3) *Metering circuit.* A portion of the rf output signal is rectified by CR1 and the resultant dc is fed through R3, FL7, and 6A1P2 pin 4 to the front panel meter (MULT position) for metering.

2-24. Frequency Multiplier Assembly 6A2

a. General. Frequency multiplier assembly 6A2 contains two separate varactor multiplier circuits, one operating as a frequency doubler and the other operating as a frequency tripler. The output harmonic frequency is selected in a tuned circuit which is ganged to the front panel XMTR TUNE control. The input frequency range of the doubler circuit is 110.0 MHz to 144.75 MHz, producing an output frequency range of 220 to 289.5 MHz (channel 40 to channel 179). The input frequency range of the tripler circuit is 96.666 to 135.0 MHz, producing an output frequency range of 290 to 405 MHz (channel 180 to channel 410). Both multiplier circuits have a series-tuned input circuit feeding the varactor. The varactor produces harmonics of its applied frequency, and feeds a series-tuned output circuit. The tripler circuit uses a second-harmonic idler circuit to increase tripling efficiency. Both multipliers have broadband input and output impedance matching circuits.

b. Detailed Circuit Analysis (fig. 6-16). For transmitter channels below 180 the incoming rf is applied to 6A12P1, the input to the doubler varactor circuit. L1, C1, and C3 form a series-tuned input circuit feeding the signal to varactor CR1. L3 provides broadband input match and R1 provides varactor self-bias. The second harmonic of the input signal is coupled through C3, C5, and L7 to output connector 6A2P2. L5 provides broadband output match. C3 is tuned to the input and output frequencies by the XMTR TUNE control. For transmitter channels 180 and above the incoming rf signal is applied to 6A2P3, the input to the tripler varactor circuit. L2, C2, and C4 are the series-tuned circuit feeding the signal to varactor CR2. L4 provides broadband input match and R2 provides varactor self-bias. L6, C7, and C8 form an idler circuit tuned to the second harmonic of the input signal. This causes the second harmonic to flow in the varactor circuit where it mixes with the fundamental strengthening the third harmonic. C4, C6, and L9 form the series-tuned output circuit. C4 and C8 are ganged to the XMTR TUNE control. L8 provides broadband output impedance matching.

2-25. RF Power Level Control 6A5

a. General. Rf power level control 6A5 limits the power level fed into radio frequency amplifier 6AR1. The level of the rf signal from electronic switch 6A1 is approximately +29 dbm ±2 db. The tolerance on this level could produce a wide range of transmitter output power variations at the PWR OUT connector and excessive power could cause over-drive within radio frequency amplifier 6AR1, reducing tube life.

b. Detailed Circuit Analysis (fig. 2-31). The incoming signal at 6A5P1 at a power level of +29 dbm ±2 db (600 to 1400 mw approximately) is fed through a 3-db resistive attenuator, R1 and R2, to the controlling element, PIN diode CR1. C1 is a dc block to permit the application of dc bias to CR1. C2 is the dc block in the output path. The cathode voltage to the output tube is applied through 6A5P2 and 6A5FL1 to Zener diode CR2 (8.2v). This voltage increases with the level of rf signal applied to the driver stage of 6AR1. When the cathode voltage exceeds 8.2 volts, zener diode CR2 will fire and apply a forward bias to PIN diode CR1. CR1 will then conduct part of the rf signal to ground. This action establishes a feedback control, attenuating the rf signal in the correct proportion to insure that the output stage of 6AR1 is not overdriven. The output rf signal level, controlled within the range of 200 to 300 mw, is fed through 6A5J2 to the driver stage of radio frequency amplifier 6AR1.

2-26. Radio Frequency Amplifier 6AR1

a. General. Physically, radio frequency amplifier 6AR1 makes up most of the transmitter rf head, and forms a framework on which the following subassemblies are mounted:

Rf amplifier subassembly	A1
Circuit card assembly	A2A2
Filter assembly	A2A4
Radio interference filter	A2FL3
Low pass filter	A2FL1
Power monitor	A3

(1) Radio frequency amplifier 6AR1 amplifies the final selected transmitter frequency by about 23 db in two power amplifier stages using type 7211 lighthouse tubes mounted in tunable resonant cavities. The cavity design uses a quarter-wave folded resonator in the plate circuit (fig. 2-32). The grid-cathode resonator is of conventional form (non-folded) with capacity loading at its end. The heater connection to the amplifier tube is made through the hollow lead

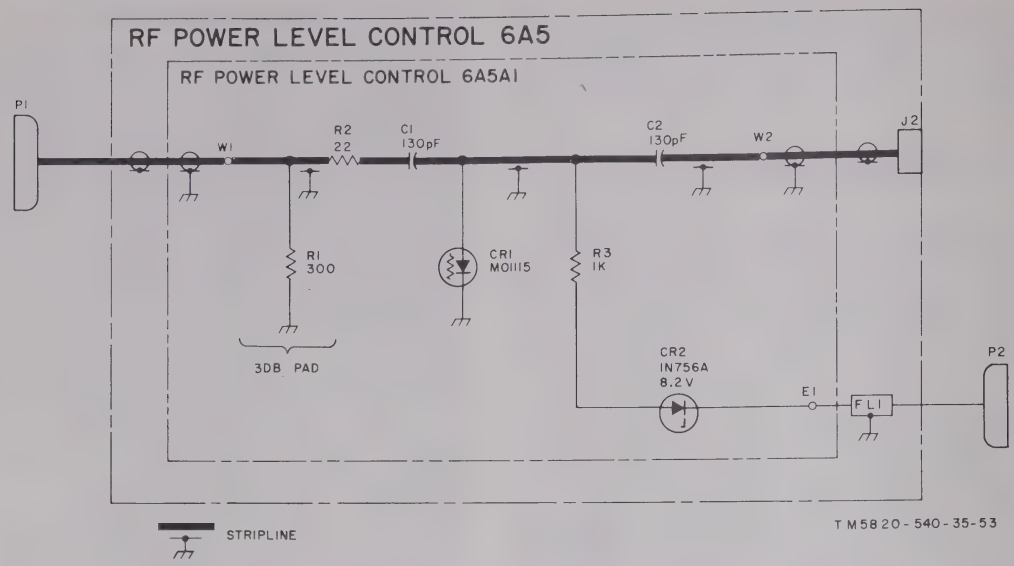


Figure 2-31. Rf power level control 6A5, schematic diagram.

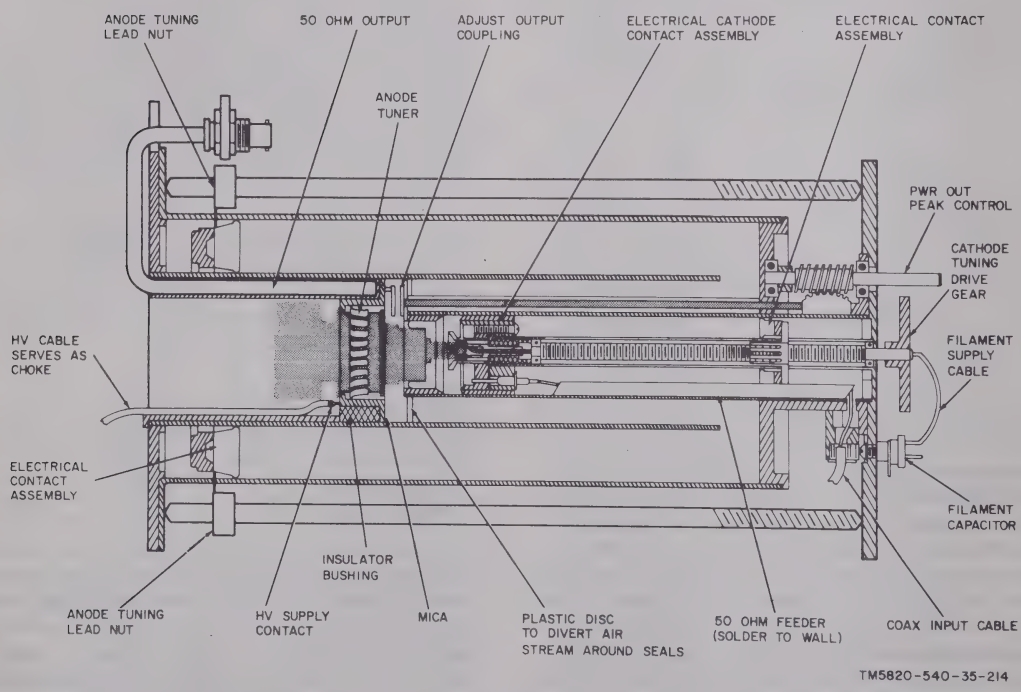


Figure 2-32. Power amplifier resonator cavity cross-section.

screw inside the center conductor of the cathode resonator. The lead screw is of a double-start nature to enable rapid transit of the tuning plungers. Due to the folded design, the plate tuning

assembly is moved toward the gear face to tune to higher frequencies, whereas the cathode assembly moves in the opposite direction. Cathode feed is taken in through a connection which is adjacent to the gear plate. This is then passed through a small coaxial cable, firmly bonded to the inside of the grid-cathode resonator cavity, and fed through the cathode contact assembly to the cathode. Dc isolation is achieved within the cathode contact assembly. The plate supply is decoupled by a capacitor integral to the amplifier tube socket; the capacitor is a silvered mica disc in a potted assembly.

(2) Tuning the cathode and plate resonator cavities is accomplished by adjusting mechanically coupled plungers, ganged to the XMTR TUNE control. This control is also ganged to the variable tuned circuits in frequency multiplier assembly 6A2. Cavity output coupling is by capacitive probe; peaking is accomplished by adjusting the PWR OUT PEAK control on the front panel. This control is pushed in to engage the driver probe drive gears and pulled out to engage the output probe drive gears.

b. Block Diagram Analysis (fig. 2-33). The rf signal from rf power level control 6A5 is fed through the driver section of filter assembly 6AR1A2A4 into the cathode of driver tube V2. The filter assembly is used to prevent rf feedback to the power supply on the cathode dc line; it also provides impedance matching of the rf input line which would otherwise be mismatched by connecting the line to a dc point. V2 amplifies the rf signal by 13 db (to about 4 watts). The output of the driver tube is fed through the output section of filter assembly 6AR1A2A4 to the cathode of output tube V1, where the signal is amplified by a further 10 db. Filament and cathode supplies to the power amplifier tubes are also fed through filter assembly 6AR1A2A4. Filament voltages and cathode circuits for the two amplifier tubes are applied through adjustment and monitoring circuits in circuit card assembly 6AR1A2A2. Test points and potentiometers permit adjustment of circuits, and this assembly also contains a facility for monitoring the driver tube power. The rf signal from output stage V2 is fed into low pass filter 6AR1A2FL1 which attenuates all harmonics of the fundamental. The filtered rf signal is then fed through power monitor 6AR1A3 and the PWR OUT connector to the duplexer in the receiver rf head and on to the

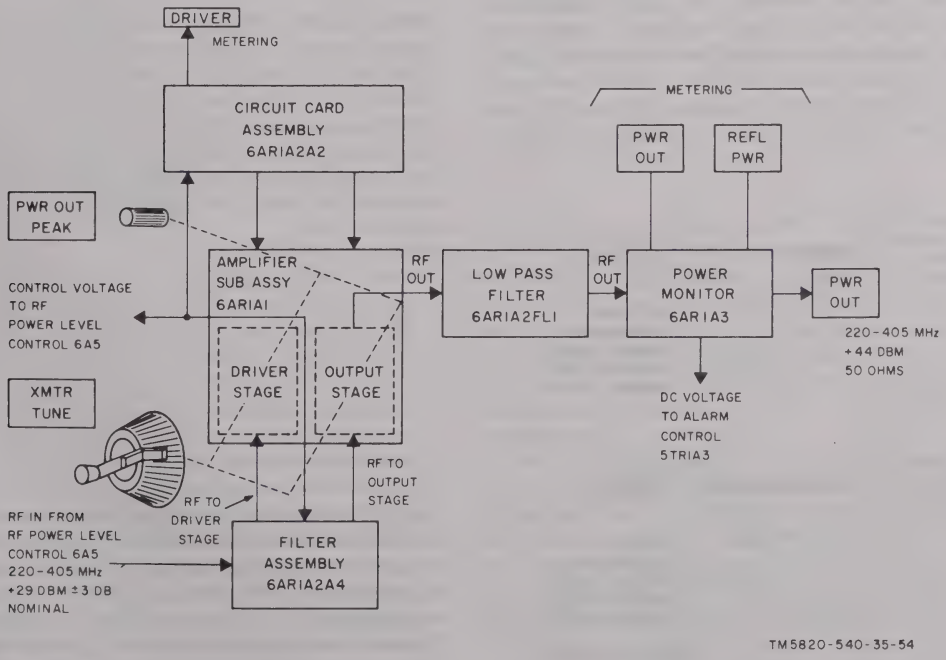


Figure 2-33. Radio frequency amplifier 6AR1, block diagram.

antenna. Power monitor 6AR1A3, a bidirectional coupler with rf pick-up loops, provides dc metering signal for forward and reflected transmitter power. Part of the forward power metering signal is also fed to alarm control 5TR1A3 (para 2-20) for LOW POWER alarm indication.

c. Detailed Circuit Analysis.

(1) *Filter assembly 6AR1A2A4* (fig. 2-34). The filter assembly has two sections, one section providing impedance matching and rf decoupling on the driver tube cathode connection, and one providing impedance matching and rf decoupling on the output tube cathode connection. Variable capacitors C1 and C2 are adjusted for the best broadband impedance match and coils L1 and L2 provide rf isolation. Heater and cathode supplies are connected to the driver and output tubes through FL1 and L1, and FL2 and L2 as shown.

(2) *Rf amplifier subassembly 6AR1A1* (fig. 2-35). The driver amplifier and the output amplifier are mechanically and electrically identical, the only difference being in the choice of the dc operating point, which is externally adjustable. The plate resonators share a common drive screw. The output matching conditions, however, are different and individual drivers are required for the output probes. The power amplifier is a conventional tuned-cathode, tuned-plate grounded-grid triode amplifier circuit. V2 is the driver stage amplifier, Z3 the cathode resonator and Z4 is the plate resonator. C7 and C8 are dc bypass capacitors. C10 is a cathode rf bypass capacitor, and C16 is a smoothing capacitor. The input signal is fed to the cathode from filter assembly 6AR1A2A4 at a level of 200 milliwatts to excite cathode resonator Z3, connected between cathode and grid. The signal at the plate resonates in Z4, connected between the plate and grid, and is coupled from the cavity to output jack J1 through output coupling probe C12. Driver peaking is accomplished by adjustment of the PRW OUT PEAK control in the pushed-in position. The output from the driver tube is connected through the second section of filter assembly 6AR1A2A4 to the cathode of output tube V1, in a circuit similar to the V2 circuit. Here it is amplified, then coupled out of the plate cavity by output coupling probe C6. Output peaking is accomplished by adjustment of the PWR OUT PEAK control in the pulled-out position. Tube filament voltages (fig. 2-36) are set to 6. 6volts dc to provide a filament current of about 1.3 amperes. Cathode currents are regulated by a constant current source within transmitter power supply 5TR1PS1 (para 2-18) to 60 milliamperes into the driver cathode and 160 milliamperes into the output cathode. The currents are set by adjustments on circuit card asssembly 6AR1A2A2.

Regulating the cathode currents in this manner extends tube life well in excess of 5,000 hours. Plate supply for the two tubes is 630 volts dc at about 180 milliamperes, supplied through radio interference filter 6AR1A2FL3, and applied to the plates through chokes L2 and L4 formed by wiring inside the cavities. **A cross-section of the cavities is shown on figure 2-32.**

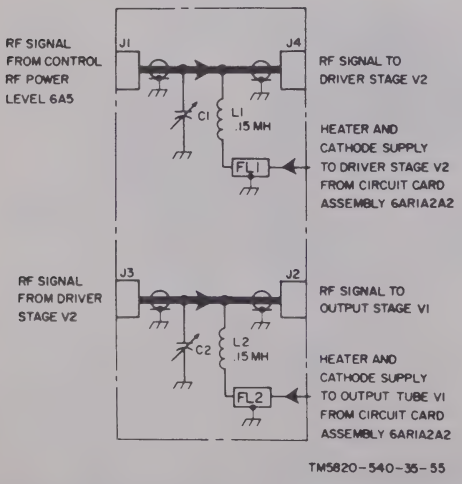
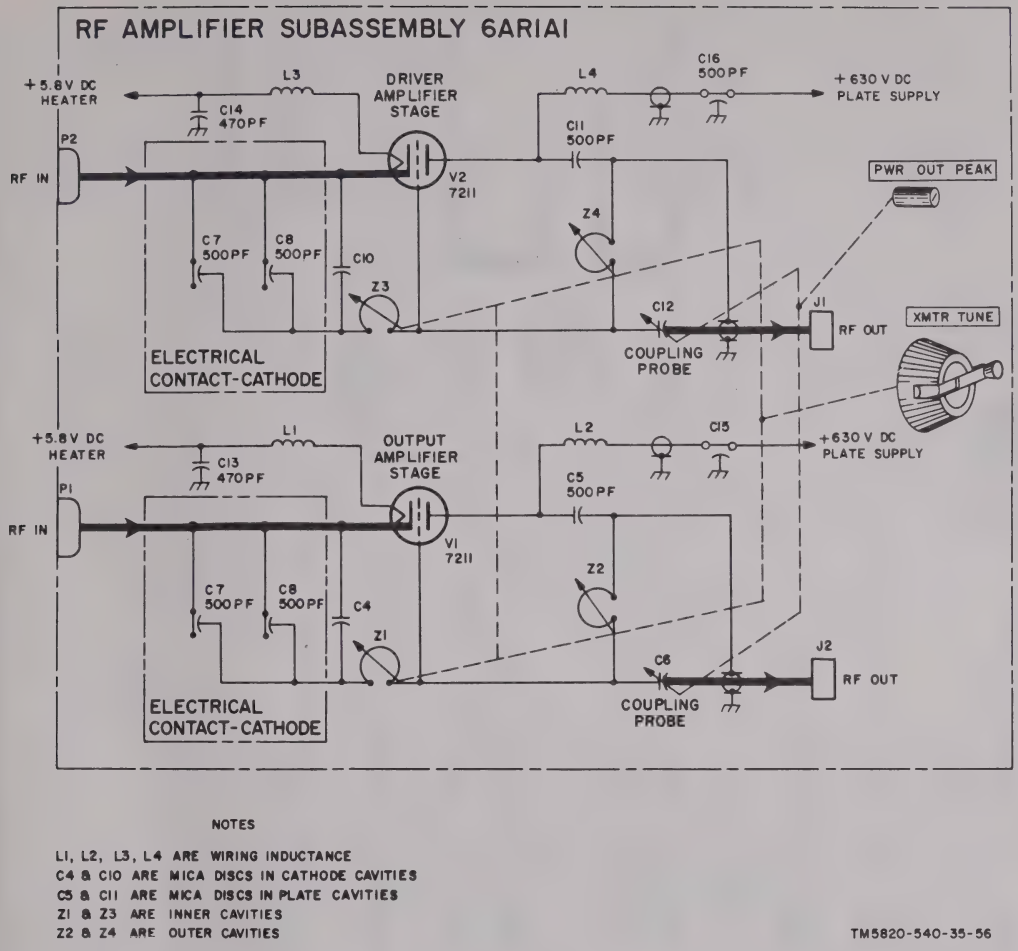


Figure 2-34. Filter assembly 6AR1A2A4, schematic diagram.

2-32.

(3) *Circuit card assembly 6AR1A2A2* (fig. 2-37). This assembly contains several test points and an elapsed time indicator. Four adjustable resistors mounted on a nearby bracket are used in conjunction with the test points in the circuit card assembly and a multimeter to adjust the filament voltages and cathode currents of the power amplifier tubes. A metering circuit (DRIVER position) detects the presence of drive into the output stage. This circuit is connected



NOTES

L1, L2, L3, L4 ARE WIRING INDUCTANCE
C4 & C10 ARE MICA DISCS IN CATHODE CAVITIES
C5 & C11 ARE MICA DISCS IN PLATE CAVITIES
Z1 & Z3 ARE INNER CAVITIES
Z2 & Z4 ARE OUTER CAVITIES

TM5820-540-35-56

Figure 2-35. Rf amplifier subassembly 6AR1, schematic diagram.

through E9, R4, and L4 into the cathode circuit of the output amplifier tube. Part of this voltage is also fed to rf power level control 6A5 for limiting the amount of drive (para 2-25). Two test points, TP3 and TP2, are provided in the heater circuit of the driver and output amplifier respectively. Externally mounted resistors, R3 and C4, in the heater line accommodate variations of tube filament circuits and are used to adjust the heater voltages. TP6 and TP7 are test points in the cathode current circuits of the driver and output amplifier respectively; the two constant current networks located in transmitter power supply 5TR1PS1 (para 2-18) are connected to the respective power amplifier tubes through variable resistors R1 and R2 and terminals E3 and E8 respectively. An elapsed time indicator on this board indicates tube running time. This device contains a thin column of mercury with a small quantity of electrolyte within the column. A constant current will cause the mercury to travel through the electrolyte, causing the electrolyte to move along the column at a constant rate. The device is graduated in 1000 hours increments and can indicate up to 10,000 hours running time.

(4) *Low pass filter 6AR1A2FL1.* Since the two cavities in which the tubes are mounted are one-quarter wave resonators, they will pass the fundamental and all odd order harmonics. Low pass filter 6AR1A2VL1 is a sealed unit having a very sharp cut-off and providing at least 45 db attenuation at 600 MHz (3 x 220 MHz). Passband insertion loss is approximately 5 db.

(5) *Power monitor 6AR1A3.* This unit has a coaxial line containing two inductive rf pick-up loops, one to pick up forward power, and one to pick up reflected power. Both rf signals are

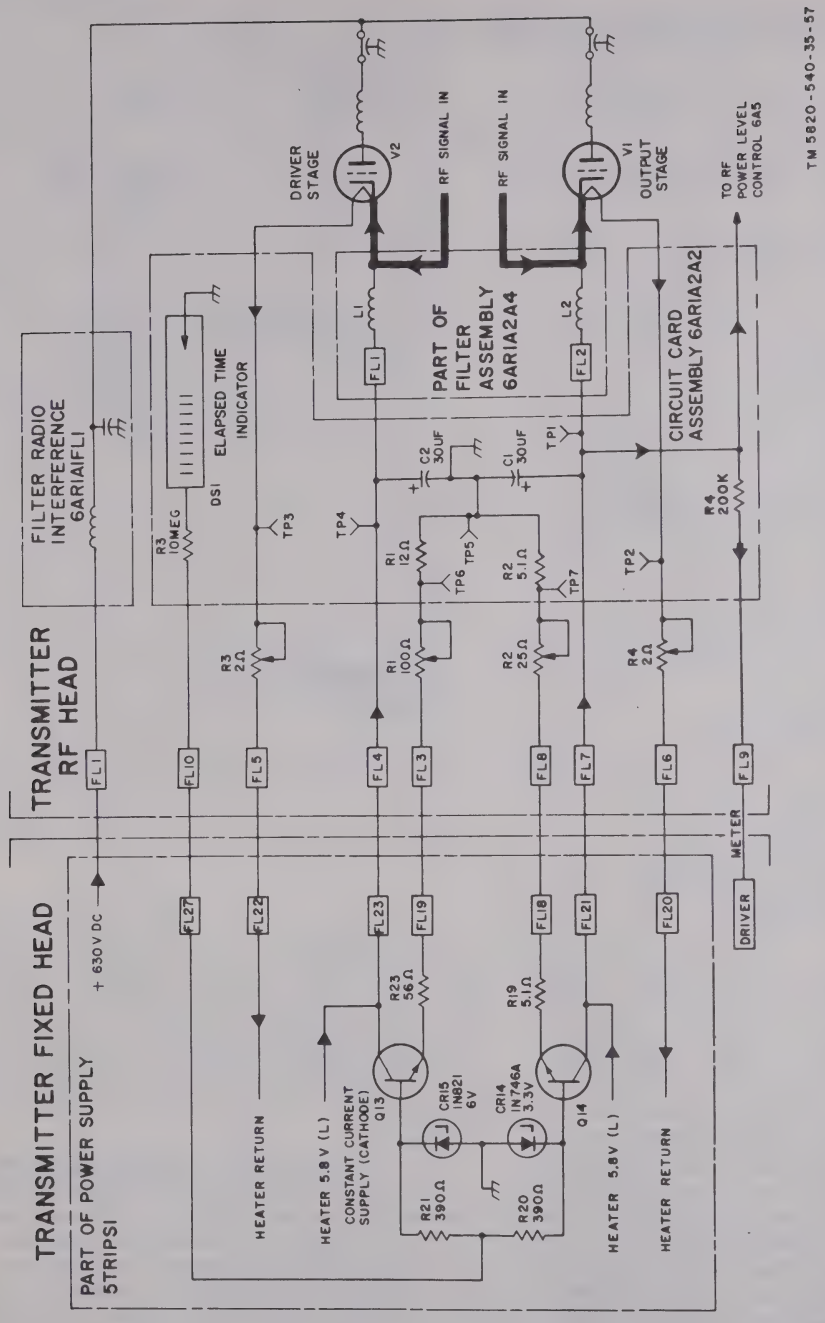


Figure 2-36. Power amplifier tubes dc and rf supplies, simplified schematic.

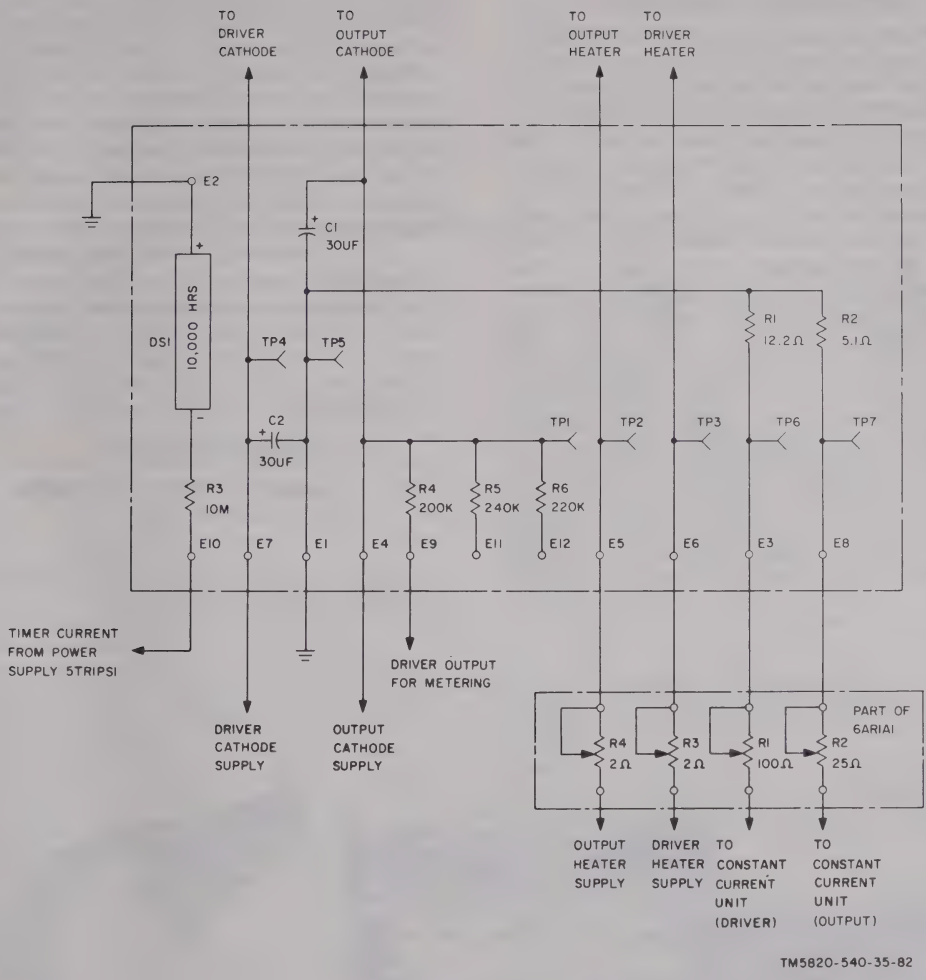


Figure 2-37. Circuit card assembly 6AR1A2A2, schematic diagram.

rectified to produce dc metering signals, and thermistors are used to compensate the temperature characteristics of the rectifying diodes. The forward power metering signal is fed to the meter through the selector switch in the PWR OUT position. It is also fed in parallel to the input of alarm control 5TR1A3 (para 2-20). The control alarm will initiate a LOW POWER alarm if transmitter output power should drop by 8 db to about 4 watts. A 5,000-ohm resistor is switched into the circuit when the meter selector switch is in any other position, in order that the monitor signal will not be disturbed by switching the meter to the PWR OUT position. The reverse power metering signal is fed to the meter through the selector switch in the REFL PWR position. This metering function is used primarily to assist the operator while tuning the XMTR DUPL control on the receiver rf head. Minimum meter reading indicates correct tuning of the transmitter portion of the duplexer in the receiver rf head.

2–27. Control-Indicator 6A3 or 2A2

a. General. Control-indicator 6A3 (transmitter channel selector) and 2A2 (receiver channel selector) are identical in function and construction (fig. 2–38). Each channel selector provides 11 control lines (3 through 13) to synthesizer 5TR1A2 or 1RE1A2. To select the required synthesizer frequencies, control lines 3 through 12 are switched on and off in a binary pattern, with line 13 switched between channel 179 and 180 to change the synthesizer output frequency steps. The switching modules are operated by a set of cams and followers which reflect the various coding patterns as shown in the coding tables (fig. 6–17); each selection is presented on the front panel display (XMTR CHANNEL or RCVR CHANNEL by means of a numerical counter. In the transmitter, control line 13, in addition to changing the synthesizer output frequency steps, is also used to switch in the 3.5 db attenuator within amplifier-monitor 5TR1A5 (para 2–2) and to change the frequency multiplication factor from times-2 to times-3 (para 2–22).

b. Description of Operation. The channel selector consists of a bank of 10 cam-operated microswitches, a front panel channel indicator, and a multiplier changeover decoder circuit. The 10 microswitches are operated by cams which establish a binary code to preset the required stages of programmed counter in synthesizer 5TR1A2 or 1RE1A2. The front panel channel indicators consist of a series of geneva-operated wheels, each having a series of numbers painted on it. The indicating wheels are geared to the microswitch cams and to a front panel knob. The transmitter channel selector display indicates the channel rather than the frequency selected. The following formulas should be used to translate a selected channel into a frequency and vice vera.

(1) Transmitter frequency =

$$\frac{\text{Transmitter channel} + 200\ \text{MHz}}{2}$$

(2) Transmitter channel = (Transmitte
frequency (MHz) -200) x 2.

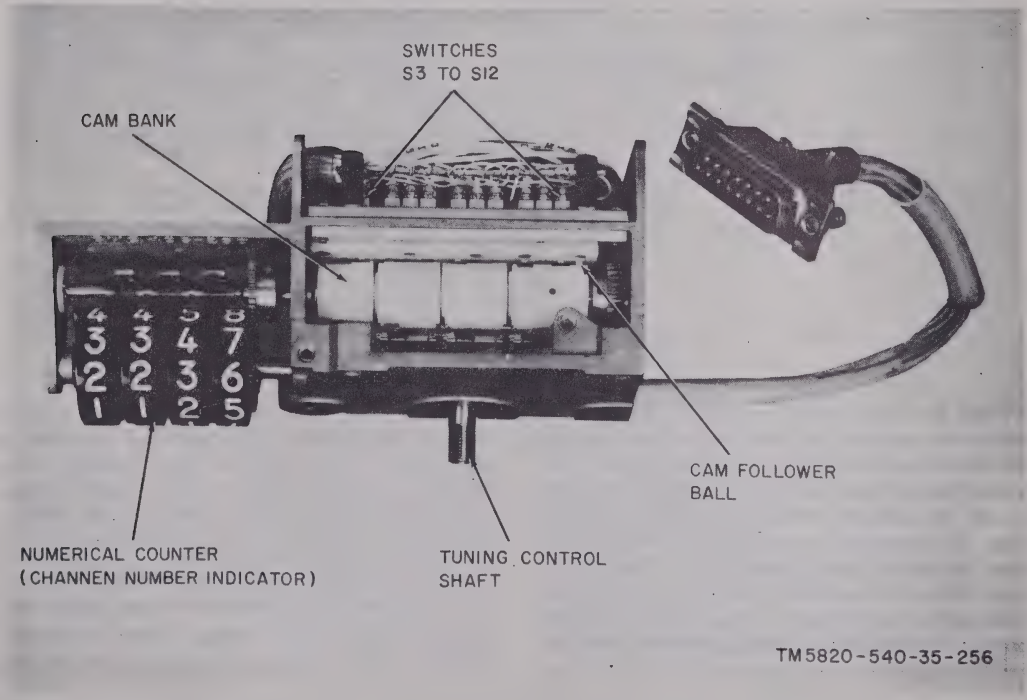


Figure 2-38. Control-indicator 6A3 or 2A2, cover removed.

On the receiver channel selector the coding is arranged to produce a local oscillator frequency 30 MHz higher than the channel indicated in the display.

This is done to permit the indicator to refer to the received signal frequency, the actual local oscillator frequency being always 30 MHz higher to provide the correct intermediate frequency.

The decoder unit is an encapsulated logic circuit designed to sense channel coding on 8 of the 10 microswitch output lines and initiate control line 13 switching to establish multiplication changeover, which takes place between channels 179 and 180 in the transmitter and channels 119 and 120 in the receiver.

Section III. AMPLIFIER-CONVERTER AM-4316/GRC-103(V)

2-28. Functional Block Diagram Analysis of Amplifier-Converter AM-4316/GRC-103(V)

(fig. 2-39)

a. Amplifier-Converter AM-4316/GRC-103(V) (receiver rf head), incorporates a duplexing system which enables the radio set to use a single antenna for both transmit and receive functions, and circuits which convert the incoming receive signals into a 30-MHz intermediate frequency.

b. Receiver rf head duplexer 2A1A1 provides the necessary isolation and impedance matching between the transmit and receive signals. The rf power at the PWR OUT connector of the transmitter rf head at a level of 25 watts is fed through an external rf coaxial cable through the FROM XMTR connector on the front panel of the receiver rf head to the two-cavity (transmit) portion of bandpass filter assembly 2A1A1A1. The tunable transmit filter is manually tuned to the transmit channel by the XMTR DUPL control. The ±2 MHz bandwidth of the filter provides additional filtering of the transmit signal while presenting a high attenuation to the received frequency. The rf signal is then directed through impedance matching network 2A1A1Z1 and power monitor 2A1A5 to the ANT. connector, and by cable to the antenna system. Power monitor 2A1A5 samples the forward and reflected rf power to the antenna system. These samples are rectified and the resulting dc voltages are used for XMTR DUPL and REFL PWR metering.

c. The receiving circuits of the receiver rf head accept modulated signals in the frequency range of 220 to 405 MHz, at a level of –54 dbm to –94 dbm and convert them to a 30-MHz intermediate frequency (IF) which is then amplified and demodulated in the receiver fixed head. The signals from the antenna, applied to the ANT. connector by lead-in cable are fed through impedance matching network 2A1A1Z1 to bandpass filter assembly 2A1A1A1, a four-cavity 3-MHz bandwidth tunable bandpass filter. This bandpass filter, part of duplexer 2A1A1, is manually tuned to the receiver frequency by the RCVR SIG control. The received signal is then fed through a high-signal protection circuit (receiver protection circuit) which prevents rf signals greater than –10 dbm from getting into the receiver. This device, electronic switch 2A4, is essentially a single-pole double-throw rf switch which is operated by changing bias voltages on PIN diodes. A high signal condition opens the normal rf signal path and diverts the high signal to electrical dummy load 2A3, where it is dissipated. The required bias voltages for the operation of electronic switch 2A4 are supplied by power supply 2PS1. The power supply 2PS1 also provides a HIGH SIGNAL alarm indication.

d. The rf signals, below –10 dbm, are fed through low pass filter 2A1A1FL1, part of duplexer 2A1A1, to attenuate all odd harmonics of the incoming frequency. The output of the low pass filter is fed into low-noise, broadband radio frequency amplifier 2A1AR1 which has a fixed gain of 27 db ±3 db over the entire frequency range of 220 to 405 MHz. The output of radio frequency amplifier 2AR1AR1 is fed into electronic frequency converter 2A1A2 whose function is to mix the received rf signal with the local oscillator signal to produce the 30 MHz IF signal. The converter contains the post-amplifier and local oscillator filters, bandpass filter assembly 2A1A2A3, frequency multiplier 2A1A2A1, frequency mixer stage 2A1A2A2, and intermediate frequency amplifier 2A1A2AR1. The single section post-amplifier section of bandpass filter assembly 2A1A2A3 rejects the noise (at the image frequency) present in radio frequency amplifier 2A1AR1.

e. The input to frequency multiplier 2A1A2-A1 is the output of amplifier-frequency multiplier 1RE2A5, in the range of 95 to 145 MHz The frequency multiplier doubles the input frequen-

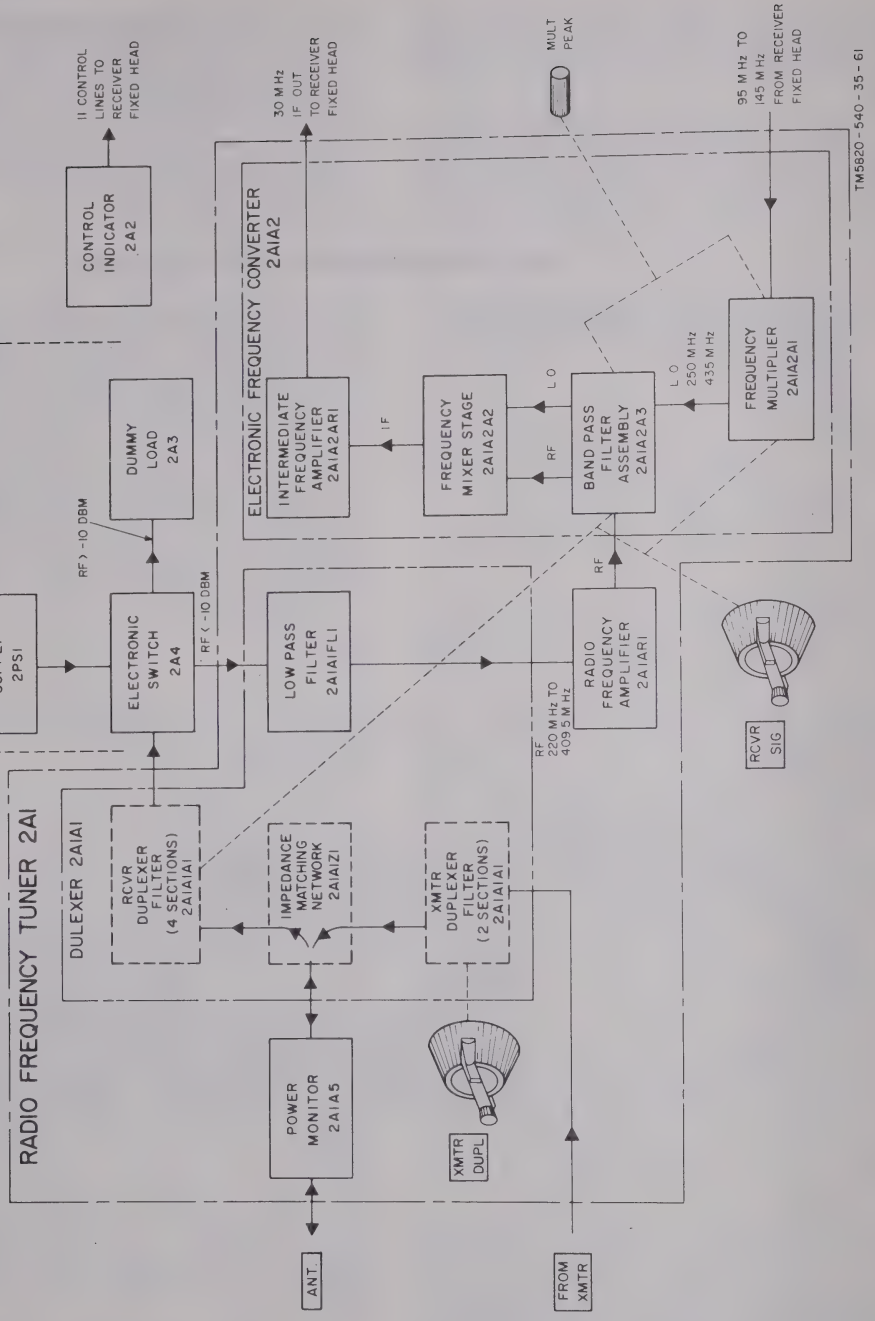


Figure 2-39. Receiver rf head, block diagram.

cy over one portion of the band and triples it over the remaining portion, to produce a continuously variable output frequency 30 MHz above the frequency of the received signal. Mechanically, the frequency multiplier is ganged to the RCVR SIG control which also drives bandpass filter assembly 2A1A1A1 and bandpass filter assembly 2A1A2A3. The RCVR SIG control adjusts the frequency multiplier and bandpass filter assembly 2A1A2A3 to a point near the required tuning point, approximately 30 MHz above the frequency of the received signal. The MULT PEAK control then tunes the frequency multiplier and both the post-amplifier and local oscillator filters of bandpass filter assembly 2A1A2A3 to their required tuning point. The ganging of the RCVR SIG and MULT PEAK is such that the three-section local oscillator filter is always tuned 30 MHz above the single-section post-amplifier filter. The received rf signal and the local oscillator signal are both fed into frequency mixer stage 2A1A2A2. The frequency mixer stage produces the 30-MHz IF signal, with a 2-db conversion loss. The IF. signal is then amplified in intermediate frequency amplifier 2A1A2AR1. A portion of the local oscillator signal, detected at the input to the mixer, is rectified to provide the MULT metering voltage. The intermediate frequency amplifier is part of the IF amplification system which also includes bandpass filter 1RE1FL1 and intermediate frequency amplifier 1RE1AR2 in the receiver fixed head. Intermediate frequency amplifier 2A1A2AR1 contributes the first 30 db of the 80 db gain provided by the IF amplification system. Automatic gain control of two stages in each of the two IF amplifiers provides automatic adjustment of overall gain over a range of 50 db, depending on the input signal Intermediate frequency amplifier 2AR1A2AR1 is a broadband device, all shaping being done in bandpass filter 1RE1–FL1.

f. Operating voltages, +12 and –12v regulated and 26v unregulated, required for the circuits in the receiver rf head, are supplied by power supply 1RE1PS1 in the receiver fixed head. A separate power supply, 2PS1, supplies the high dc voltage required to operate electronic switch 2A4 of the receiver protection circuits. An overall schematic diagram of the receiver rf head is shown in figure 6–18.

2–29. Duplexer 2A1A1

a. General. Since Radio Set AN/GRC–103 (V)1 operates with a single antenna, duplexer 2A1A1, part of radio frequency tuner 2A1, provides the necessary isolation between the transmitted signal and the receiver. The duplexer consists of bandpass filter assembly 2A1A1A1, impedance matching network 2A1A1Z1, and low pass filter 2A1A1FL1. Bandpass filter assembly 2A1A1A1 consists of six tuned cavities and two channel frequency indicators.

b. Detailed Circuit Analysis (fig. 6–14).

(1) *Transmitting path.* The transmitter portion of bandpass filter assembly 2A1A1A1 consists of two quarter-wave resonant tuned cavities, 2A1A1A1Z5 and 2A1A1A1Z6. The cavities are connected in series with capacitive input and output probes. Both cavities are tuned in parallel with adjustable plungers controlled by the XMTR DUPL front panel control. The channel to which the transmit cavities are tuned is indicated by channel frequency indicator 2A1A1A1DS2 in the XMTR CHANNEL display window. The filter has a passband of ±2 MHz and an insertion loss of 1 db nominal. The output of the cavities is connected through a coaxial T-junction to impedance matching network 2A1A1Z1, which matches the impedance of the transmitter to the antenna throughout the operating frequency band. The transmitter output is then fed through power monitor 2A1A5 to the antenna; power monitor 2A1A5 measure the forward and reverse (reflected) power of the transmitted signal.

(2) *Receiving path.* The received signal from the antenna is connected through power monitor 2A1A5 and impedance matching network 2A1A1Z1 to the coaxial T-junction between the transmit and receive sections of bandpass filter assembly 2A1A1A1. The transmit filter presents a high impedance at the receive frequency and the receive signal is directed into the receive section of the duplexer. The receive section consists of four quarter-wave resonant tuned cavities 2A1A1A1Z1, Z2, Z3, and Z4, similar to those in the transmit section. All four cavities are tuned in parallel by adjustable plungers controlled by the RCVR SIG front panel knob The frequency to which the receive cavities are tuned is indicated by channel frequency indicator 2A1A1A1–DS1 in the RCVR CHANNEL display window. The receive filter has a passband of ±3 MHz and an insertion loss of 1.5 db. The signal from the receive cavities is fed through the receiver protection switch circuits (para 2–31) and back into the duplexer's low-pass filter 2A1AFL1. This filter is a sealed, lumped-constant device mounted in a coaxial shield and provides approximately 35 db rejection at all frequencies above 660 MHz (3 times the lowest fundamental).

(3) *Impedance matching network 2A1A1–Z1.* This unit consists of two coaxial stub lines and two trimmer capacitors connected across the through coaxial line, to match the transmit and receive filters to the antenna over the entire frequency range of 220 to 405 MHz. Trimmer capacitors C1 and C2 are accessible for adjustment.

(4) *Tuning mechanism of bandpass filter assembly 2A1A1A1.* The gear box on which bandpass filter assembly 2A1A1A1 is mounted contains two main shafts, one for the transmitter, and the other for the receive section. The transmitter drive shaft, XMTR DUPL, (fig. 2–40) is connected to two bevel gears which drive the two individual center conductor drive screws of the resonant cavities. Similarly the receiver drive shaft, RCVR SIG, (fig. 2–41) is connected to four bevel gears which drive the four individual center conductor drive screws of the receiver resonant cavities.

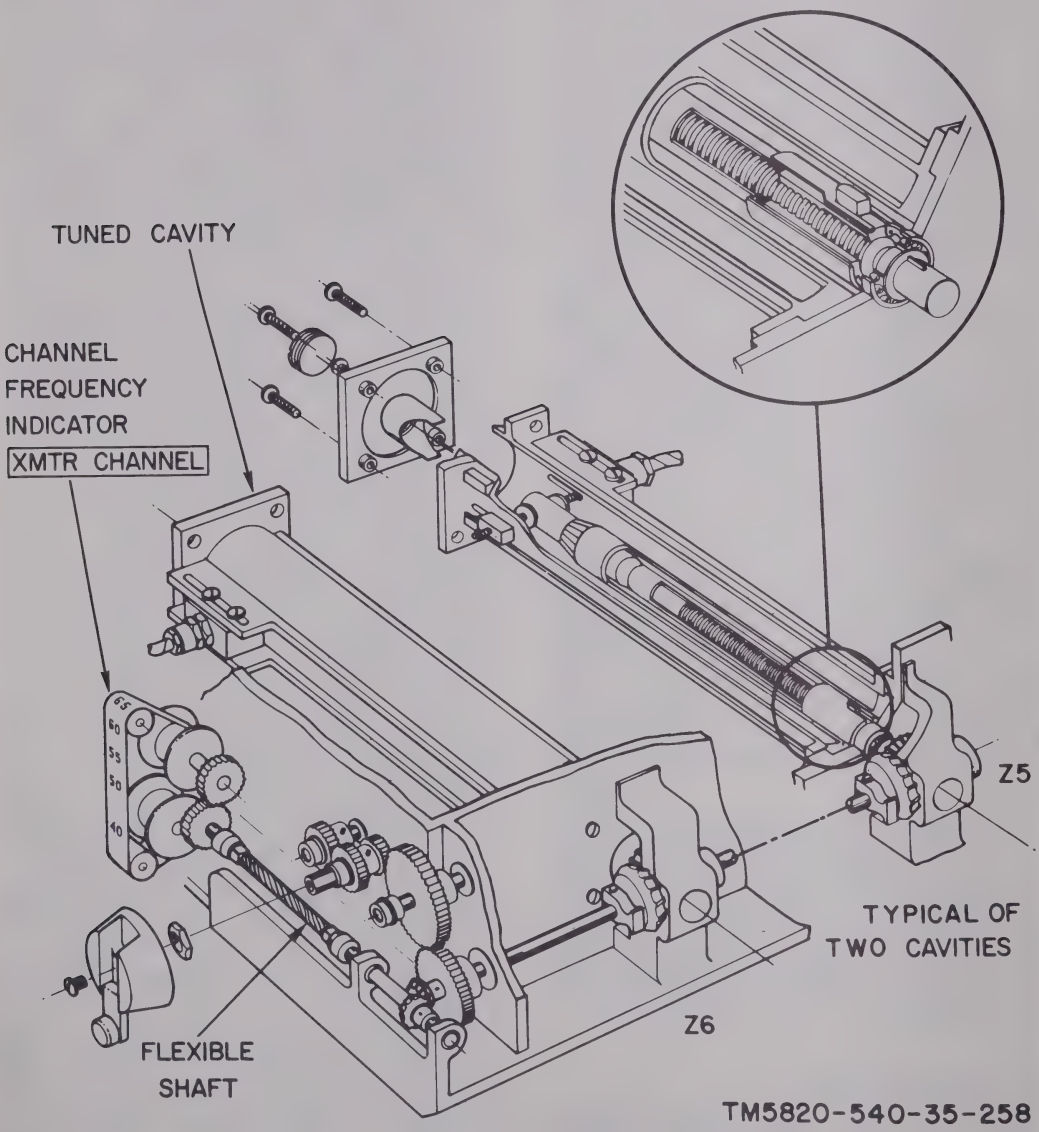


Figure 2-40. Bandpass filter assembly 2A1A1A1 transmitter section tuning mechanism.

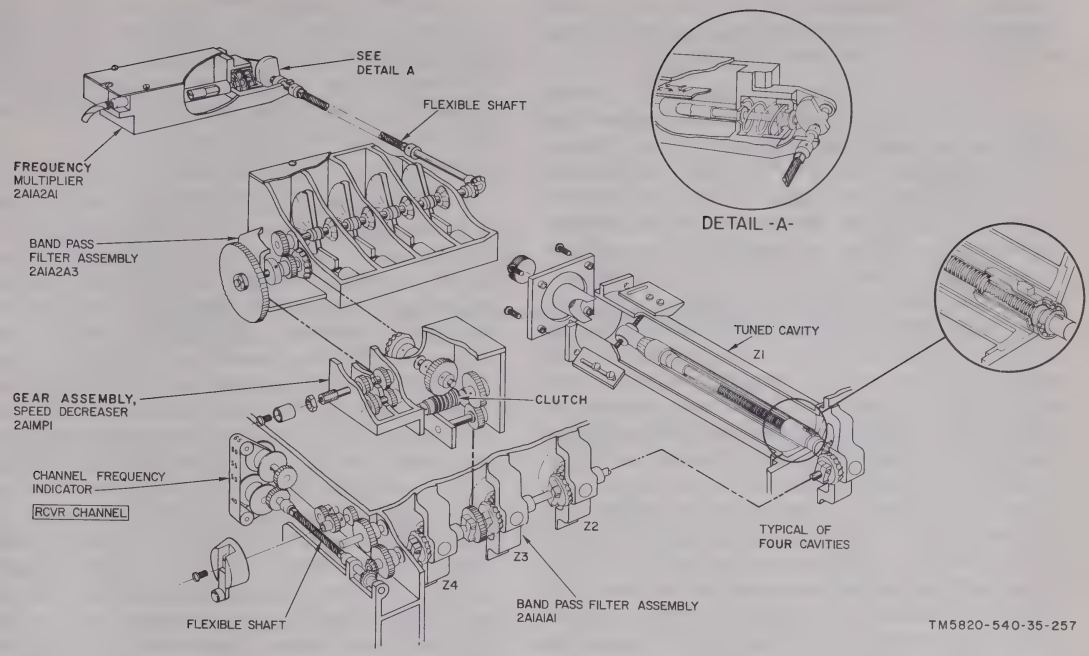


Figure 2-41. Bandpass filter assembly 2A1A1A1 receiver section tuning mechanism.

2–30. Power Monitor 2A1A5

Power monitor 2A1A5, located in the receiver rf head, is fitted in the antenna line between impedance matching network 2A1A1Z1 and the antenna connector (ANT.) on the front panel of the equipment (fig. 6–18). The power monitor consists of a bidirectional coupler with integral detectors and temperature compensation circuits. It samples the output power to the ANT. connector and the reflected power from the antenna, rectifies the rf signals and feeds the resulting dc voltages to the meter on the front panel of the receiver fixed head. This provides appropriate meter readings when the meter switch is in either the XMTR DUPL or REFL PWR position. The unit operates in an identical manner to power monitor 6AR1A3 (para 2–26).

2–31. Receiver Protection Switch

a. General. The receiver protection switch is a single-pole double-throw switching device inserted between the receive section of bandpass filter assembly 2A1A1A1 and low pass filter 2A1A1–FL1. The receiver protection switch prevents any high-level signals from being fed into radio frequency amplifier 2A1AR1 and damaging it. The high-level signals can be either the transmitter output, if the receiver has been tuned to the same channel as the transmitter, or signals received from nearby external sources. The protection switch consists of electronic switch 2A4, power supply 2PS1, and electrical dummy load 2A3.

b. Block Diagram Analysis (fig. 2–42). The received rf signal at the output of bandpass filter assembly 2A1A1A1 is fed into electronic switch 2A4. Electronic switch 2A4 consists of two separate subassemblies: electronic switch 2A4A1 and electronic switch control 2A4A2. Electronic switch 2A4A1 consists of a stripline connected switch with two PIN diodes in the receive arm and one PIN diode in the load arm. Under normal conditions, the receive arm PIN diodes are forward biased, while the load arm PIN diode is zero biased. A PIN diode has a variable rf impedance which varies from less than one ohm when forward biased to several thousand ohms when zero volts or a reverse bias is applied to it. By varying the applied voltage the diode changes very rapidly from the high impedance condition to the low impedance condition. The rf signal is normally routed through forward-biased PIN diodes of the receive arm directly to the output

connector. The normal received signal sees a high impedance in the load arm due to the absence of bias on the load arm PIN diode.

(1) A tunnel diode, operating as a back-diode detector, is connected to the receive arm stripline to sense the received rf level. When this level reaches –10 dbm the diode will switch to a positive output voltage to drive the microcircuit amplifier on electronic switch control 2A4A2. A reference dc input to this amplifier is adjusted by the TRIG LEVEL ADJ control to set the amplifier operating point, and, therefore, the signal switching level. The high gain of the amplifier results in an extremely fast switching operation. The amplifier output to the emitter-follower stage is a negative voltage under high-signal conditions. The emitter-follower stage has two outputs. One output, the alarm drive, is used to operate the switching circuits in power supply 2PS1, when a high signal is detected in the receive arm. The switching action will apply a forward bias of 3 volts to the load arm PIN diode, reducing its rf impedance to less than one ohm, and applies a 97-volt reverse bias to the receive arm PIN diodes. The high rf signal is then directed through the load arm to electrical dummy load 2A3, where it is dissipated.

(2) The second output is fed through a differentiating circuit to switch sampling transistor Q2. The differentiating circuit, which has extremely fast rise time and a relatively slow decay time, controls the switch sampling action. This sampling action takes place under high signal condition when no rf power is fed to the detector in the receive arm to keep it operated.

(3) Switching transistor Q3 controls the reversing action of the bias on the receive arm diodes. The normal bias on the receive arm diodes is a 100-volt potential on the positive side applied through a bias reversing stage, and a +94 volts return at the negative side. When the switch operates, the +100 volts supply line is open and the positive sides of the diodes are clamped at ground potential. This results in a reverse bias of 94 volts being applied to the receive arm diodes.

(4) The alarm drive signal at the output of Q1, electronic switch control 2A4A2, is fed into power supply 2PS1 where it is amplified and used to operate relay drive transistor Q1. A second output from the relay drive transistor is fed to load bias transistor Q5. This transistor turns on the 3-volt forward bias to the PIN diode in the load arm in electronic switch 2A4A1.

(5) Power supply 2PS1 supplies the high-level reverse bias to the receive arm PIN diodes for high signal level isolation. It also provides a 200-volt dc supply, and the 3-volt supply which is used to forward bias the load arm PIN diode under high signal conditions.

c. Detailed Circuit Analysis.

(1) *Electronic switch 2A4* (fig. 6–19). The rf input signal, arriving from the receive section of bandpass filter assembly 2A1A1A1 to connector P3, is coupled through C2 to the PIN diodes in the receive arm, CR1 and CR2, and then fed through dc blocking capacitors C1 and C4 and connector P2 to low pass filter 2A1A1FL1. Normally, diodes CR1 and CR2 are forward biased; +94v dc is applied to the cathodes of CR1 and CR2 through L1, while +100v dc is applied to the anode through R1 and L2, resulting in a 6v dc forward bias. L1 and L2 prevent the rf from getting into power supply 2PS1 through the dc lines. Load arm diode CR3 is normally zero biased; bias current is applied to CR3 through L3 and C7 (less negative) on one side and L4 and C8 (more negative) on the other side, so that at a low input power (less than –10 dbm) the load arm presents an isolation of at least 20 db. A portion of the rf signal passing through the receive arm is detected by diode CR4 in series with filter L6 and C9. The output of tunnel diode CR4 is fed to the non-inverting input, pin 3 of microcircuit differential amplifier A1 of electronic switch control 2A4A2. R1, R2, and R3 set a dc reference voltage at pin 2 of the differential amplifier; R2, the TRIG LEVEL ADJUST control, sets the rf switching level. A1 is a high-gain differential dc amplifier which amplifies the dc potential between pins 2 and 3. The output at pin 7 is coupled directly to the base of emitter-follower Q1. The output at the emitter of Q1 is used as an alarm drive and as a switch drive. The alarm drive is applied through connector P1 pin D to power supply 2PS1; the switch drive is applied through CR2 and C4 to the base of transistor Q2. The collector load, R10, of Q2 is connected to the +200v dc base supply; the collector of Q2 is also connected to the base of Q3 switching transistor. In the normal operating condition, there is no signal available from the back-diode detector, so that the input at pin 3 is negative relative to the input at pin 2 of the amplifier; the output at pin 7 of the amplifier is negative in this condition. Feedback from output pin 7 is coupled through R4 and CR1 to pin 2. CR1 provides limiting of the feedback level to avoid amplifier saturation, which

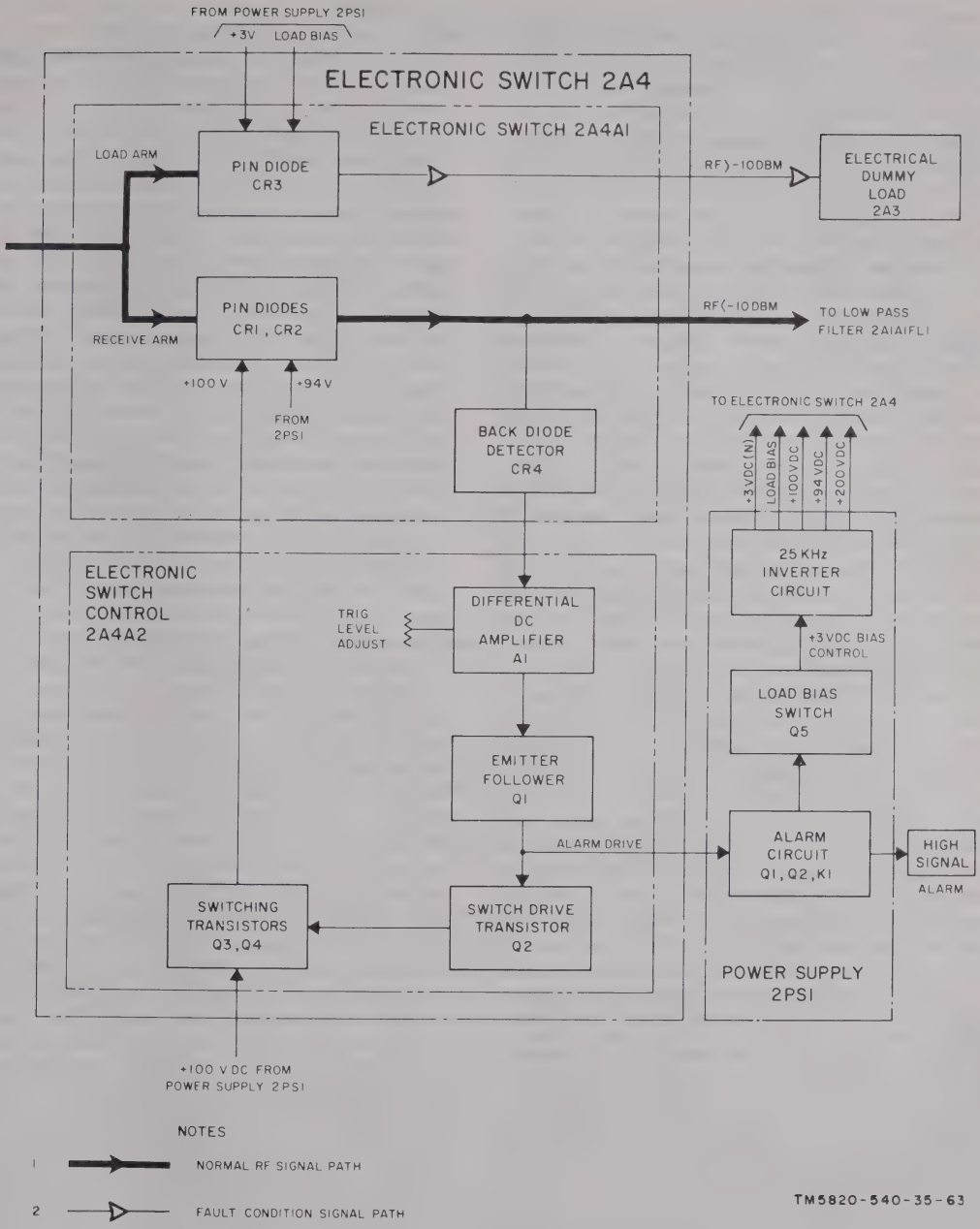


Figure 2-42. Receiver protection switch, block diagram.

could cause a recovery delay and slow the amplifier switching time. C3 provides frequency compensation feedback. This negative output voltage, fed through emitter-follower Q1 to the base of transistor Q2 through CR2 and C4, is insufficient to make Q2 conduct and therefore Q2 is cut-off. Receive arm bias, +100v dc, is fed through Q3 to PIN diodes CR1 and CR2 in elec-

tronic switch 2A1A1; the other sides of the receive arm diodes (cathodes) are connected to +94v dc. As long as Q2 is cut off, the base of Q4 is fed from +200v through R10. Q3 and Q4 conduct and do not present any appreciable impedance to the bias supply to the PIN diodes. Consequently, in the normal condition, a steady dc bias is allowed to pass through the PIN diodes. In the event of high input rf power, a voltage from the back-diode detector is fed to pin 3 of the differential amplifier. When this voltage is greater than the voltage set by R2 of the amplifier, the amplifier, because of its extremely high gain, swiftly changes its negative output at pin 7 to a positive output voltage which is transmitted through emitter-follower Q1, through diode CR2 and network CR4 and R9, to the base of Q2, making Q2 conduct. When Q2 is turned on the voltage at its collector drops rapidly from +200 volts to zero while resistor R10 drops the base supply. The drop in voltage at the Q2 collector causes Q4 and Q3 to cut off removing the +100-volt potential from the anodes of the receive arm pin diodes, leaving the +94 volts potential at their cathodes. The +94 volts thus becomes a reverse bias which presents a high impedance to rf in the receive arm path. CR3 at the Q3 emitter will clamp the anodes of the receive arm pin diodes to about 0 volt through Q2, providing a return path for the dc signal, and only a voltage larger than 100v rf peak applied to the PIN diodes can make them conduct again. However, when the circuit goes into the isolate condition, tunnel diode CR4 ceases to pass any signal back to the amplifier circuit so that the amplifier tends to return to its normal nonoverload condition; this re-establishes a nonoverload condition and allows a small amount of rf signal to pass to the PIN diodes in the receive arm which trips the circuit once again. This results effectively in a sampling action. The sampling "OFF" time, during which the PIN diodes are cut-off and Q2 is conducting, is determined by the time constant of Q2 base circuit CR2, C4, R8 and R9. The time required to drive the PIN diodes from cut-off into conduction and bring Q2 from saturation to cut-off is the sampling "ON" time, and is determined by the time constant of Q2 collector circuitC7 and R10. The sampling "ON" and "OFF" times are 15 microseconds and 33 microseconds respectively, giving a sampling rate of approximately 21 kHz.

(2) *Power supply 2PS1* (fig. 2-43). The alarm drive signal from the Q1 emitter is coupled through inter-unit wiring and R4 to the base of Q2 in power supply 2PS1. Under high-signal conditions this is a positive signal which turns on Q2. The operating point of the alarm circuit is set by +12v dc, applied to the base of Q2 through R3. The collector of Q2 is connected through R2 to the base of PNP transistor Q1; therefore when Q2 conducts, Q1 conducts also, and alarm relay K1 is turned on, closing the 24v path to the HIGH SIGNAL alarm circuit. The positive signal at the Q1 collector is also coupled through R10 to the base of Q5, turning it on. Q5 is in series with a 3-volt supply which is connected back to the load arm PIN diode in electronic switch 2A4A1. This voltage then becomes a forward bias to load arm diode CR3, reducing its rf impedance and providing an rf path to electrical dummy load 2A3. The power supply circuits consist of a 25-kHz inverter transformer, T1, and transistor switching circuit Q3 and Q4. When -12v input voltage is applied through L2 to the circuit, -11v dc appears between terminal 5 of the inverter transformer T1 and emitters of Q3 and Q4, across C7. Bias voltage is applied to the bases of transistors Q3 and Q4 through terminals 4 and 6 of transformer T1. Q3 is cut-off while Q4 is conducting, and the voltage appearing at the collector of Q3 remains there until the transformer saturates (a period of 1/25,000 second); as saturation is reached, voltages of opposite polarity are induced in all windings, causing a reversal of current and voltage relationship between Q3 and Q4, with Q4 cut-off while Q3 is conducting. The resulting output voltage is a dc square wave with a frequency of 25 kHz. The 200v ac, 25-kHz square wave at terminals 7 and 8 is rectified in a conventional bridge rectifier; CR2, CR3, CR4, and CR5. The resultant +200v dc is fed as a base drive for switching transistors Q3 and Q4 in electronic switch control 2A4A2, through two resistors, R5 in power supply 2PS1 and R10 in electronic switch control 2A4A2. The voltage across secondary windings 9, 10, and 11 is rectified in CR6 and CR7 to give 6v peak across C8. The upper side is connected to the +100v dc line, derived from divider R6 and R7, so that the potential of the receiver bias line is 94 volts. The voltage across C8 is fed from the +100v line through L4 and 2PS1 pin 9 to electronic switch control 2A4A2 through Q3, in series with PIN diodes CR1 and CR2 in the receive arm, and back to the 94-volt line to forward bias the PIN diodes under normal operating conditions. The ac voltage across secondary windings 12, 13 and 14 is rectified by CR8 and CR9 so that 3v dc is developed across C9. This voltage is fed through transistor Q5 (normally cut-off) and chokes L6 and L7 to the load arm to reverse bias PIN diode CR3; Q5 operates in conjunction with the alarm circuits as described above.

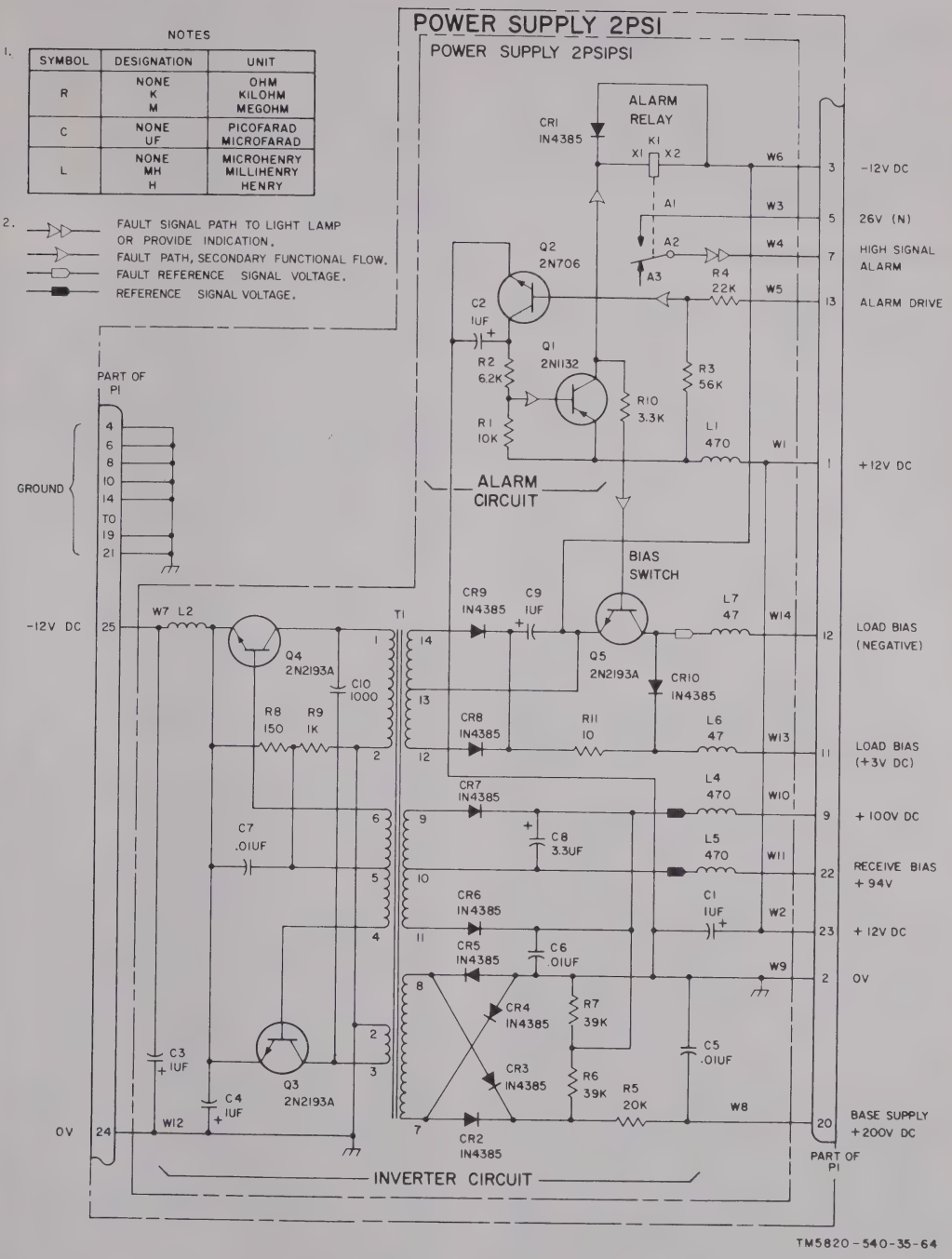


Figure 2-43. Power supply 2PS1, schematic diagram.

(3) *Electrical dummy load 2A3.* The electrical dummy load is a dissipative element in series with the load arm PIN diode and uses the gear box of the receiver rf head as a heat sink. The rf signal is fed into the center conductor of the electrical dummy load through a coaxial line. A single ground plane is used as the resistive element, and the heat is dissipated through the cast aluminum housing.

2–32. Radio Frequency Amplifier 2A1AR1

a. General. Radio frequency amplifier 2A1AR1 is a low-noise, wideband, four-stage fixed-gain amplifier with a stable output, inserted in the receive signal path of the receiver front end, providing 27 db +3 db gain over the entire frequency range of 220 to 405 MHz, independent of input impedance. The circuit is a conventional stagger-tuned, cascaded amplifier, using low-noise transistors. Since radio frequency amplifier 2A1AR1 is the first active device in the receiver amplifier chain, it establishes the overall noise performance of the receiver. The noise figure of the 2A1AR1 is better than 6 db, giving a receiver noise figure of better than 9 db.

b. Functional description. The incoming received signal from low pass filter 2A1A1FL1 (para 2–29) is amplified in a four-stage amplifier. The four stages are stagger-tuned to provide a bandwidth covering the full frequency range. Low-noise T1XM101 germanium PNP transistors are used for the first two stages, while silicon NPN transistors with good temperature stability are used for the remaining two stages. The first stage is tuned at about 325 MHz, the second at about 220 MHz, the third at about 375 MHz, while the fourth stage provides a relatively flat gain across the entire band. Stage one is connected in a common-emitter configuration which provides good stability; the remaining three stages are connected in a grounded base configuration for broad bandwidth. After amplification, the signal is fed through a 9-db matching attenuator pad to bandpass filter assembly 2A1A2A3. The gain of the amplifier is linear for signals with input levels of up to –30 dbm, while gain compression occurs for input levels above –30 dbm.

c. Detailed Circuit Analysis (fig. 6–20). The incoming receiver rf signal at J1 is coupled through the C1 and L12 input matching circuit to the Q1 base. Q1 is a common-emitter configuration to insure stability under all input load conditions. Trimmer capacitor C1 is the only tuning element in radio frequency amplifier 2A1AR1. The remaining three stages, Q2, Q3, and Q4, are in a grounded base configuration which provides best performance in gain and bandwidth. L2, L4, L6, and L8 are the frequency determining elements. All but two transformer coils are air-core coils which are adjusted during manufacture by shaping or shorting the turns of wire. The 9 db pi-type attenuator, R14, R16, and R17 in the output circuit provides stability of operation in the output stage, and a closer match to the 50-ohm nominal impedance.

2–33. Electronic Frequency, Converter 2A1A2

a. General. The electronic frequency converter, 2A1A2, consists of frequency multiplier 2A1A2–A1, frequency mixer stage 2A1A2A2, and intermediate frequency amplifier 2A1A2AR1, all mounted on bandpass filter assembly 2A1A2A3. Frequency multiplier 2A1A2A1 is part of the local oscillator frequency-generating chain together with control-indicator 2A2, electrical frequency synthesizer 1RE1A2, and amplifier frequency multiplier 1RE1A5. Intermediate frequency amplifier 2A1A2AR1 is part of the intermediate frequency system, together with bandpass filter 1RE1FL1 and intermediate frequency amplifier 1RE1AR2. The bandpass filter assembly contains the post-amplifier and the local oscillator bandpass filters.

b. Block Diagram Analysis (fig. 2–44). The main function of electronic frequency converter 2A1A2 is to mix the received rf signal with the local oscillator signal to produce the 30-MHz if. signal. The rf signal from radiofrequency amplifier 2A1AR1 is fed into the post-amplifier filter section of bandpass filter assembly 2A1A2A3, which removes the image frequency noise components from the received rf signal before it is fed into frequency mixer stage 2A1A2A2. Image frequency components are not present in the output of radio frequency amplifier 2A1AR1; however, without the post-amplifier bandpass filter, the frequency mixer stage will respond to noise in radio frequency amplifier 2A1AR1 at the image frequency. The rf output of amplifier-frequency multiplier 1RE1A5 in the range of 95 to 145 MHz, at a level of +15 dbm, is fed into frequency multiplier 2A1A2A1 for multiplication. The output of the frequency multiplier is the local oscillator frequency in the range of 250 to 435 MHz at a level of +7 dbm. Frequency multiplier 2A1A2A1 doubles the input frequency over one portion of the band and triples it over the remaining portion. The output frequency is continuously variable using the front panel

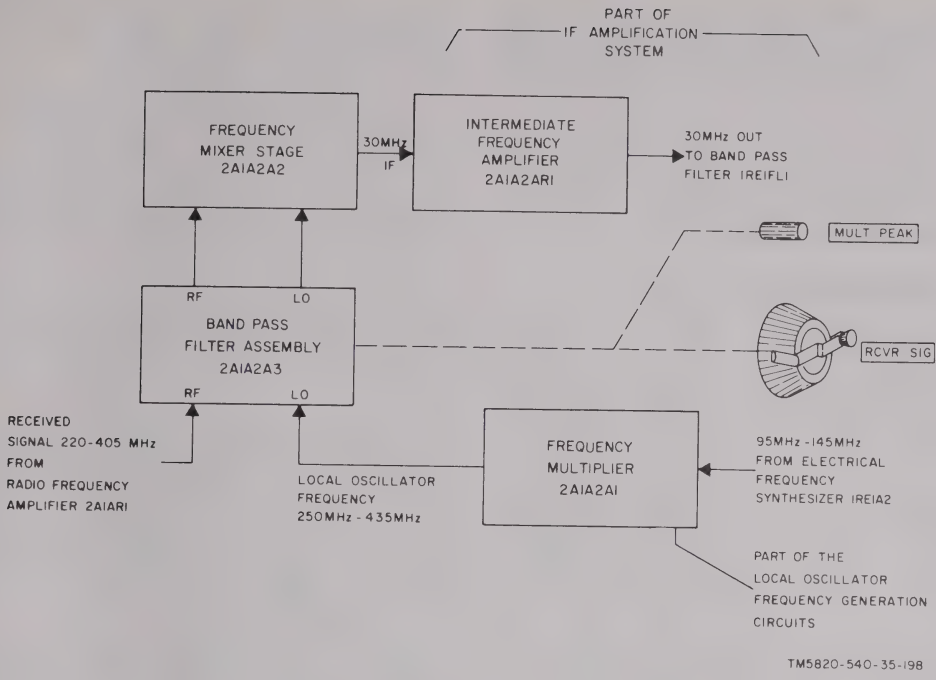


Figure 2-44. Electronic frequency converter 2A1A2, block diagram.

controls, RCVR SIG and MULT PEAK. The local oscillator frequency is fed into the local oscillator filter section of the bandpass filter assembly 2A1A2A3 which rejects all but the selected output frequency of frequency multiplier 2A1A2A1. The local oscillator and the post-amplifier filter sections are ganged so that the local oscillator filter is always tuned 30 MHz above the post-amplifier filter. The tuning range of the post-amplifier filter is 220 MHz to 405 MHz, and that of the local oscillator filter is 250 MHz to 435 MHz. The tuning mechanism of bandpass filter assembly 2A1A2A3 is coupled to the main gear drive of the receiver rf head. The tuning to the local oscillator frequency is done in the following two stages. The RCVR SIG control, which drives the four-cavity receiver filter of duplexer 2A1A1 (para 2-29), also adjusts bandpass filter assembly 2A1A2A3 and frequency multiplier 2A1A2A1 to a point near the required tuning point. The MULT PEAK control then tunes frequency multiplier 2A1A2A1 and bandpass filter assembly 2A1A2A3 to the required tuning point. The two outputs of bandpass filter assembly 2A1A2A3 are fed separately into frequency mixer stage 2A1A2A2 where they are mixed to produce the 30-MHz IF frequency, at a level of 2 db below the rf input signal. A metering signal (MULT) derived from the local oscillator signal input to the mixer stage provides an indication of the frequency multiplier output.

2-34. Bandpass Filter Assembly 2A1A2A3

a. Bandpass filter assembly 2A1A2A3 consists of a single section post-amplifier filter and a three-section local oscillator filter. Each section consists of a stripline with ganged variable capacitors providing the adjustment by effectively varying the lengths of stripline. The ganging arrangement is such that it provides a constant 30-MHz offset between the post-amplifier and the local oscillator filters.

b. Bandpass filter assembly 2A1A2A3 uses air-spaced stripline techniques; each section consists of a quarter-wavelength coaxial line cavity, capacity-loaded to reduce the length requirement, using air-spaced capacitors for both loading and tuning. The post-amplifier filter is adjusted to resonate at a constant 30 MHz below the local oscillator filter. Tuning the local oscillator filter is achieved by adjusting the vanes of the slotted variable capacitor. The tuning mechanism of bandpass filter assembly 2A1A2A3 is coupled

through a variable coupling to the RCVR SIG tuning mechanism. The MULT PEAK control provides fine tuning facilities of bandpass filter assembly 2A1A2A3 and frequency multiplier 2A1A2A1.

c. The insertion loss of the post-amplifier filter is 3.0 db and the bandwidth is 10 MHz; insertion loss of the local oscillator filter is 1.0 db and bandwidth is 4.0 MHz.

2–35. Frequency Multiplier 2A1A2A1

a. General. Frequency multiplier 2A1A2A1 provides the final local oscillator frequency by doubling the frequency of the signal from amplifier-frequency multiplier 1RE1A5 over a portion of the band, and tripling it over the remainder of the band.

Multiplication factor	Frequency Range (MHz)	
	Input	Output
Times–2	125.0 to 144.75	250. to 289.0
Times–3	96.66 to 145.0	290.0 to 435.0

Output frequency selection is continuously variable. The change in multiplication factor is accomplished by changing the input frequency to the point where the output tuned circuit will select the required harmonic. The second harmonic is selected over the required portion of the band and then the input frequency is stepped down to the point where the tuned circuit selects the third harmonic. The tuned circuit is varied by mechanical ganging to the RCVR SIG control and, through an idler trimming arrangement, to the MULT PEAK control.

b. Detailed Circuit Analysis (fig. 2–45). Input signals in the range of 95 to 145 MHz at +15 dbm are fed through J1 into the 2 db resistive matching network, R1, R2, and R3. The signal is then coupled through L1 and C2 and capacitive trimmers C3 and C4 to the emitter of harmonic generator Q1. L1, C2, C3, and C4 extend the vswr frequency characteristics of the input matching circuit. C4 is used to adjust the input vswr over the operating frequency range. L2, C5, and R4 form a gain-compensation network (effectively a frequency selection matching network) at the emitter circuit of Q1, which compensates the gain/frequency roll-off characteristics of Q1.

(1) The multiplier circuit is a grounded-base transistor amplifier operating as a class–C amplifier. The output signal at the collector of Q1, rich in harmonics, is applied to L3. Variable capacitor C1 (externally mounted) and L3 form a tuned, selective filter, tuned to the required harmonic of the input frequency.

(2) Tuning is adjusted by front-panel control RCVR SIG, trimmed by front-panel MULT PEAK control. Tracking of the selective filter is adjusted by adjusting the slug in the L2 coil. C1 is a glass capacitor with a freely sliding cam-operated metal plunger. The cam movement closely follows the tuning laws of bandpass filter assembly 2A1A2A3.

(3) The direct transmission method used insures consistent tracking between frequency multiplier 2A1A2A1 and bandpass filter assembly 2A1A2A3.

(4) The selected harmonic is coupled through C7 to a 3-db matching network, R5, R6, and R7, and then to output connector P2. The output signal is in the range of 250 to 435 MHz at +5 dbm. R4 in the Q1 emitter circuit adjusts the level of the output signal and insures that the output level does not change at the multiplication changeover point.

(5) The output frequency is continuously variable, using the RCVR SIG control and an idler trimming arrangement actuated by the MULT PEAK control. To accomplish the MULT PEAK trimming function, a worm gear is permitted to slip back and forth about 1/2-inch along a square shaft before it starts driving its associated pinion gear. The worm gear is driven by the RCVR SIG control. As it turns it slips along the shaft to the stop, where it starts driving the pinion. The MULT PEAK control turns the pinion gear which then drives the worm gear along the shaft until it reaches the end of its travel. The effect is for the RCVR SIG control to drive four-cavity receiver duplexer filter 2A1A1A1Z1Z4, and adjust bandpass filter assembly 2A1A2A3 and the frequency multiplier to a point near the required tuning point; the MULT PEAK control then tunes the bandpass filter assembly and frequency multiplier 2A1A2A1 to their required tuning points.

2–36. Frequency Mixer Stage 2A1A2A2

a. General. Frequency mixer stage 2A1A2A2 converts the received rf signal to the 30-MHz IF signal by mixing the rf signal with a local oscillator signal which is always 30 MHz above the frequency of the received signal. The two separate inputs to the frequency mixer stage are the received rf signal at a level of –33 to –73 dbm, and the local oscillator signal 30 MHz above the

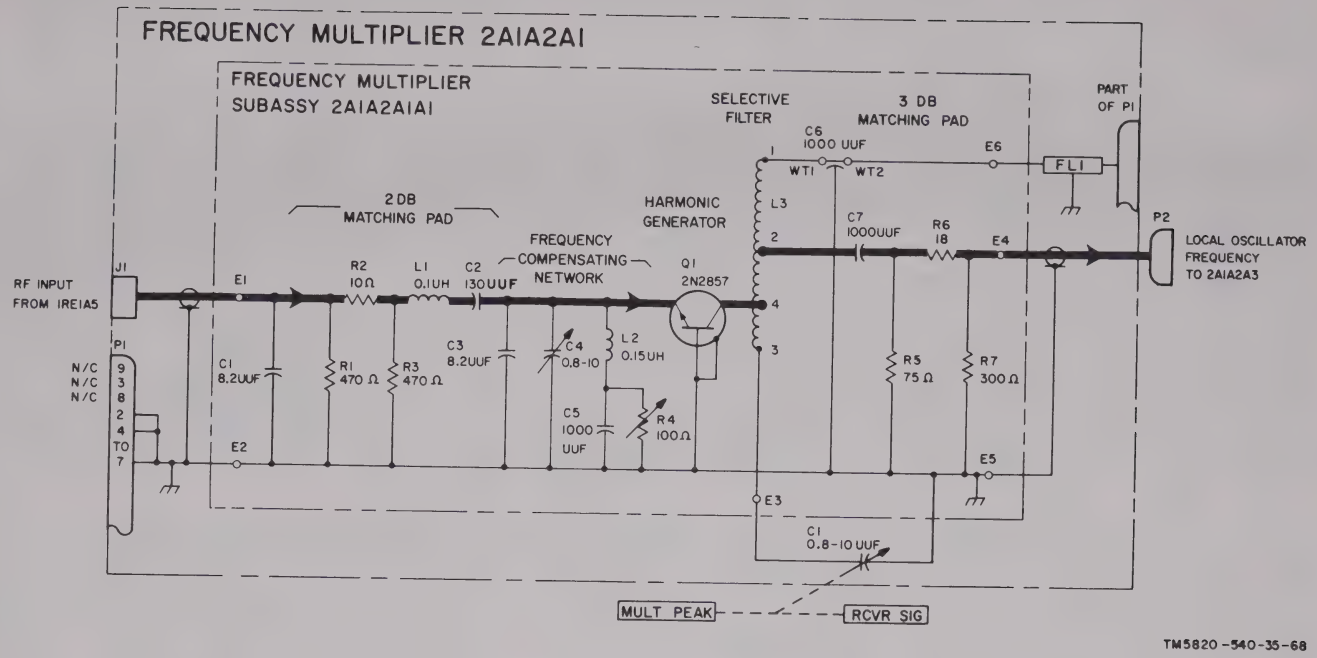


Figure 2-45. Frequency multiplier 2A1A2A1, schematic diagram.

received rf frequency at a level of +2 dbm nominal. The output of the frequency mixer stage is a 30-MHz if signal 2 db below the rf input level. The mixer also produces a signal suitable for metering the output of frequency multiplier 2A1A2A1.

b. Detailed Circuit analysis (fig. 2–46). The received rf signal is applied through P2 and a 5-db matching network, R1, R2, and R3 to the base of mixer transistor Q1. Similarly, the local oscillator signal is applied through P3 and a 17-db matching network, R10, R8, and R7 and coupling capacitor C1 to the emitter of Q1. The two resistive networks help to reduce any mutual interference between the two input signals and also provide a suitable termination for bandpass filter assembly 2A1A2A3.

(1) Mixing takes place in the emitter-base section of the transistor, which then amplifies the 30-MHz difference frequency. The amplified 30-MHz difference frequency (IF) at the collector of Q1 is fed through 30-MHz wideband coupling transformer T1 to highpass filter C7 and L4 to output connector J2.

(2) A portion of the incoming local oscillator signal is rectified in CR1 and connected through rf filter L3 to P1–4 for distribution to the meter (MULT position). L3 and C6 provide rf filtering while CR2 compresses the meter scale.

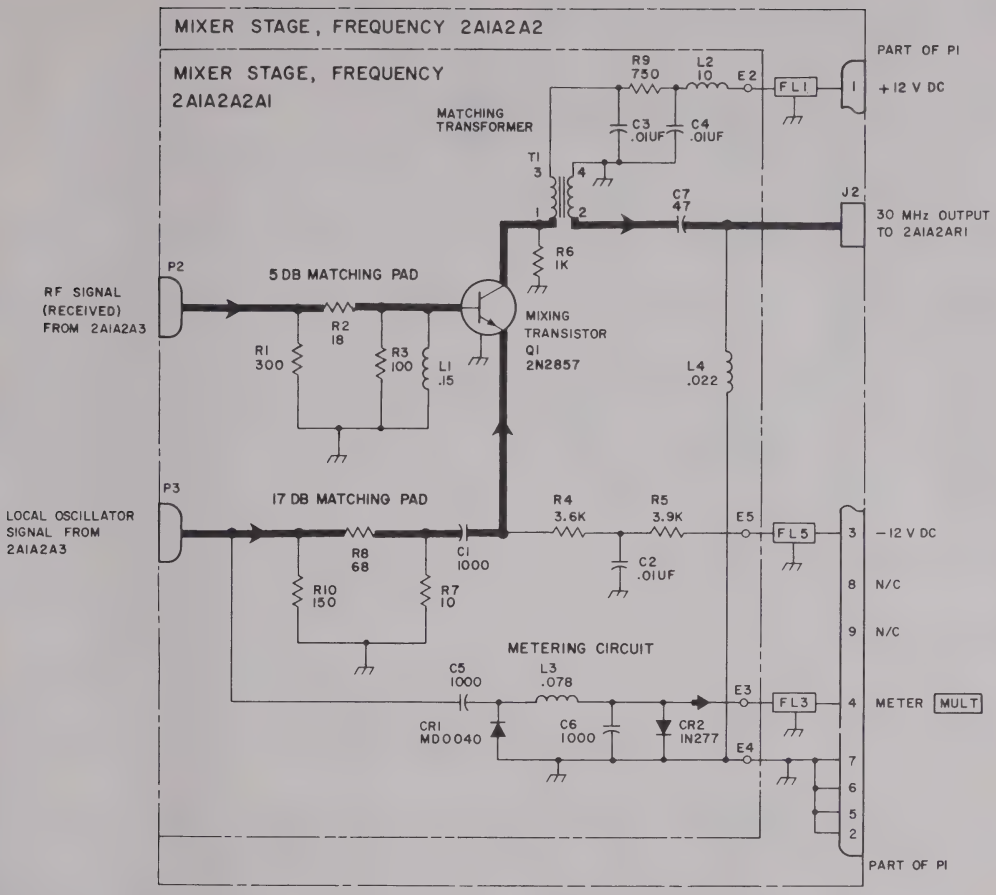
2–37. Control-Indicator 2A2

Control-indicator 2A2 is identical to control-indicator 6A3 with the exception of the coding arrangement. Coding in control-indicator 2A2 is arranged to produce a local oscillator frequency 30 MHz higher than the receiver frequency. The receiver channel is indicated on the front panel. The coding arrangement of control-indicator 2A2 is illustrated in figure 6–17. The construction and operation of control-indicator 6A3 and 2A2 are described in paragraph 2–27. Use the same formulas given in paragraph 2–27 to convert the selected channel into the receiver frequency and vice-versa. To obtain the local oscillator frequency add 30 MHz to the receiver frequency.

2–38. IF Amplifier System

a. General. The IF system in the receiver includes intermediate frequency amplifier 2A1A2AR1 (located in the receiver rf head), bandpass filter 1RE1FL1, and intermediate frequency amplifier 1RE1AR2 (both located in the receiver fixed head). The IF system can provide up to 72-db overall gain of the 30-MHz IF signal. Intermediate frequency amplifier 2A1A2AR1 provides 34-db gain, and intermediate frequency amplifier 1RE1AR2 provides 50-db gain, while the insertion loss of bandpass filter 1RE1FL1 is 12 db. Automatic adjustment of overall gain over a range of approximately 50 db, depending upon the level of input signal, is provided by automatic gain control of two stages in intermediate frequency amplifier 2A1A2AR1, and another two stages in intermediate frequency amplifier 1RE1AR2. Each of the amplifiers has a broadband response, centered at 30 MHz. All IF response shaping is done in bandpass filter 1RE1–FL1, rather than in interstage tuning circuits, to prevent detuning due to the wide operating range of the automatic gain control (agc).

b. Block Diagram Analysis (fig. 2–47). The 30-MHz IF signal from frequency mixer stage 2A1A2A2, at a level ranging from about –35 to –75 dbm (depending upon received signal strength), is fed into the first stage of intermediate frequency amplifier 2A1A2AR1. Intermediate frequency amplifier 2A1A2AR1 is a four-stage low-noise transistor amplifier, gain-controlled over a range of 15 to 40 db, and is mounted close to frequency mixer stage 2A1A2A2 to prevent noise pick-up and losses in low-level signal cabling. The first stage has a fixed gain to insure that the noise factor does not change with agc action. The second and third stages are agc controlled, their total gain being variable over a range of about 20 db; the agc voltage is generated in the main IF amplifier. The fourth stage provides impedance transformation and very little gain; the output impedance is stepped down to 50 ohms to match the input impedance to bandpass filter 1RE1FL1. Bandpass filter 1RE1FL1 is a passive device between the output of 2A1A2–AR1 and the input to intermediate frequency amplifier 1RE1AR2. The unit has a closely controlled gaussian-shaped frequency response centered on 30 MHz, with an insertion loss of 12 db. Intermediate frequency amplifier 1RE1AR2 is a five-stage transistor amplifier. The first stage has a fixed gain to insure stable noise performance and input match over the large range of agc operation. The second and third stages are agc controlled, their total gain being variable over a range of about 20 db. The fifth stage has a fixed gain and supplies a signal to the agc detector as well as a –3 dbm signal to electrical frequency limiter-discriminator 1RE1A4. The agc detector is followed by a dc



NOTES

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. MAJOR FUNCTIONAL FLOW
METERING FLOW

TM5820-540-35-71

Figure 2-46. Frequency mixer stage 2A1A2A2, schematic diagram.

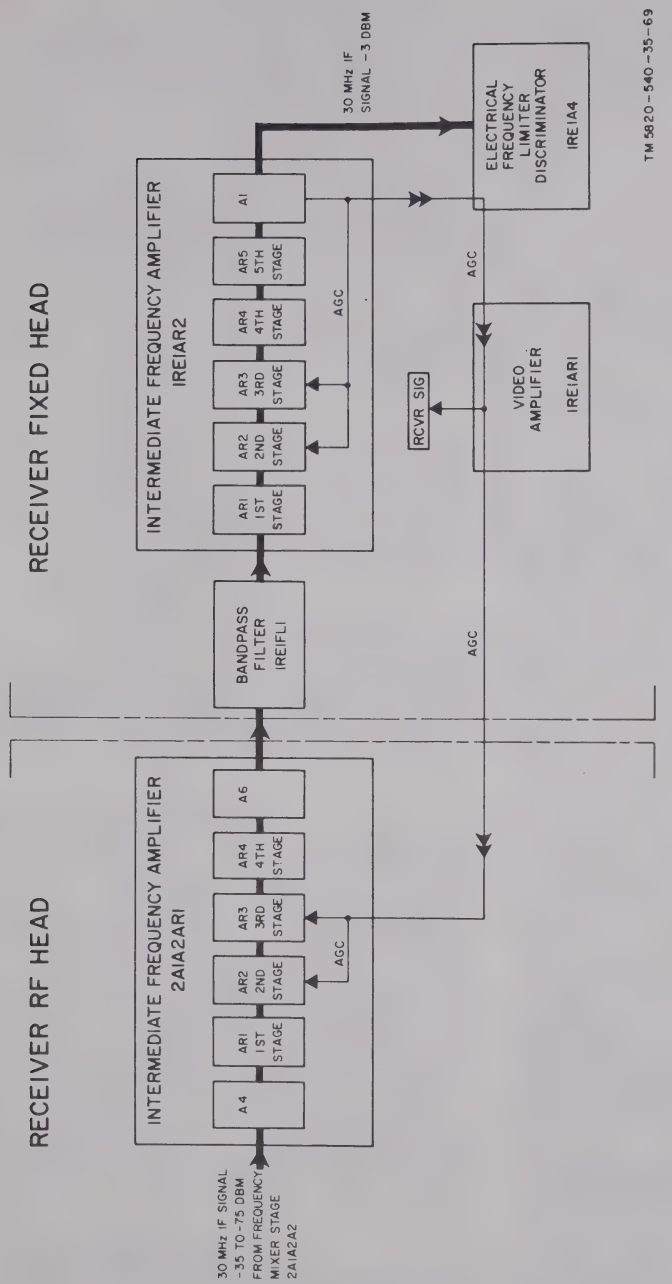


Figure 2-47. If. amplification system, block diagram.

amplifier which raises the agc voltage and increases its sensitivity to variations in the received signal level. A metering circuit (RCVR SIG) located in video amplifier 1RE1AR1 driven by the agc voltage provides monitoring facilities for the received signal.

2–39. Intermediate Frequency Amplifier 2A1A2AR1

a. General. Intermediate frequency amplifier 2A1A2AR1 is constructed by the cordwood technique. This technique groups all components of each stage within a cylindrical shape which is then inserted into a circular hole in a block of cast alumimum. This type of construction has been chosen for its excellent shielding properties. Intermediate frequency amplifier 2A1A2AR1 contains six cordwood modules, four of which are similar, single-transistor amplifier stages.

b. Detailed Circuit Analysis (fig. 6–21). The 30-MHz signal from frequency mixer stage 2A1A2A2 is coupled through C3 of amplifier subassembly 2A1A2AR1A4 to the base of Q1, a fixed-gain transistor stage. Bias for transistor Q1 is derived from a resistive divider network, R1, R2, and R3, (amplifier subassembly A4), connected across the –12v dc supply. The circuit uses a –12v emitter supply, since emitter signal decoupling is more effective due to its lower signal level potential.

The –12v dc emitter supply is fed through P2 pin 3 into electrical filter assembly 2A1A2AR1A6. L1, C1, L3 and C3 filter the –12v dc supply before it is connected to the other modules. The –12v dc is further filtered by similar decoupling circuits (L2–C1) in each module before it is applied through R1 to the emitter of the transistors in each IF amplifier module. In each IF amplifier AR1 through AR4, C2 is the emitter bypass, R2 is the collector load and L1 is the tuning element to provide a flat response. The collector output of Q1 in IF amplifier AR1 is coupled through C3 to the base of P1 in the next stage, IF amplifier AR2. The second and third amplifier stages have variable bias applied to the bases of their respective transistors. The agc voltage derived from the last stage of IF amplifier 1RE1AR2 is fed through P2 pin 6 into electrical filter assembly A6, filtered by L2 and C2, then filtered again by L3 and C4 in amplifiers AR4, AR2, and AR1 before being applied to the bases of the transistors in AR2 and AR3 through resistors R3. The variable bias applied to the bases of the second and third transistors causes the gain of these amplifier stages to decrease with increasing signal level at the output of intermediate frequency amplifier 1RE1AR2. The output stage, IF amplifier AR4, provides impedance transformation to match the intermediate frequency amplifier 2A1A2AR1 output into bandpass filter 1RE1FL1. Bias for the Q1 transistor of output stage AR4 is derived in IF amplifier AR3 from the –12v dc supply, filtered by L3, and C4, through resistive divider network, R3, R4, and R5. The output stage has a fixed gain to insure stable impedance matching when the amplifier gain is varied. The amplified 30-MHz output is then fed through P2 pin 5, and through the receiver distribution box wiring, to bandpass filter 1RE1FL1 in the receiver fixed head.

Section IV. RECEIVER, RADIO R–1329(P)/GRC–103(V)

2–40. Functional Block Diagram Analysis of Receiver, Radio R–1329(P)/GRC–103(V)

(fig. 2–48)

a. The receiver fixed head circuits shape and amplify the 30-MHz IF signal, detect and amplify the video signals, regenerate the pcm signal and extract the order wire signal, generate the basic crystal-controlled frequency used to obtain the local oscillator frequency, and provide metering and monitoring facilities.

b. Shaping of the 30-MHz IF signal is done in bandpass filter 1RE1FL1, having gaussian-type characteristics. The signal is amplified in intermediate frequency amplifier 1RE1AR2, which provides approximately 50-db gain, with an agc controlled gain over a 25-db range. The agc voltage taken from the last stage controls the gain of intermediate frequency amplifiers 1RE1AR2 and 2A1A2AR1, and is also fed to video amplifier 1RE1AR1 to provide the RCVR SIG metering facility. The 30-MHz output of intermediate frequency amplifier 1RE1AR2, at a level of –3 dbm, is fed into electrical frequency limiter-discriminator 1RE1A4, where it is demodulated to produce the combined video (baseband) and order wire signal.

c. Video signals at the output of electrical frequency limiter-discriminator 1RE1A4 are shaped and amplified in video amplifier 1RE1AR1. The video amplifier provides three outputs: 12-channel pcm video to pulse form restorer 1RE1A3, pcm regeneration and order wire extraction; 24-channel pcm video at the receiver case VIDEO connector; and fdm video at

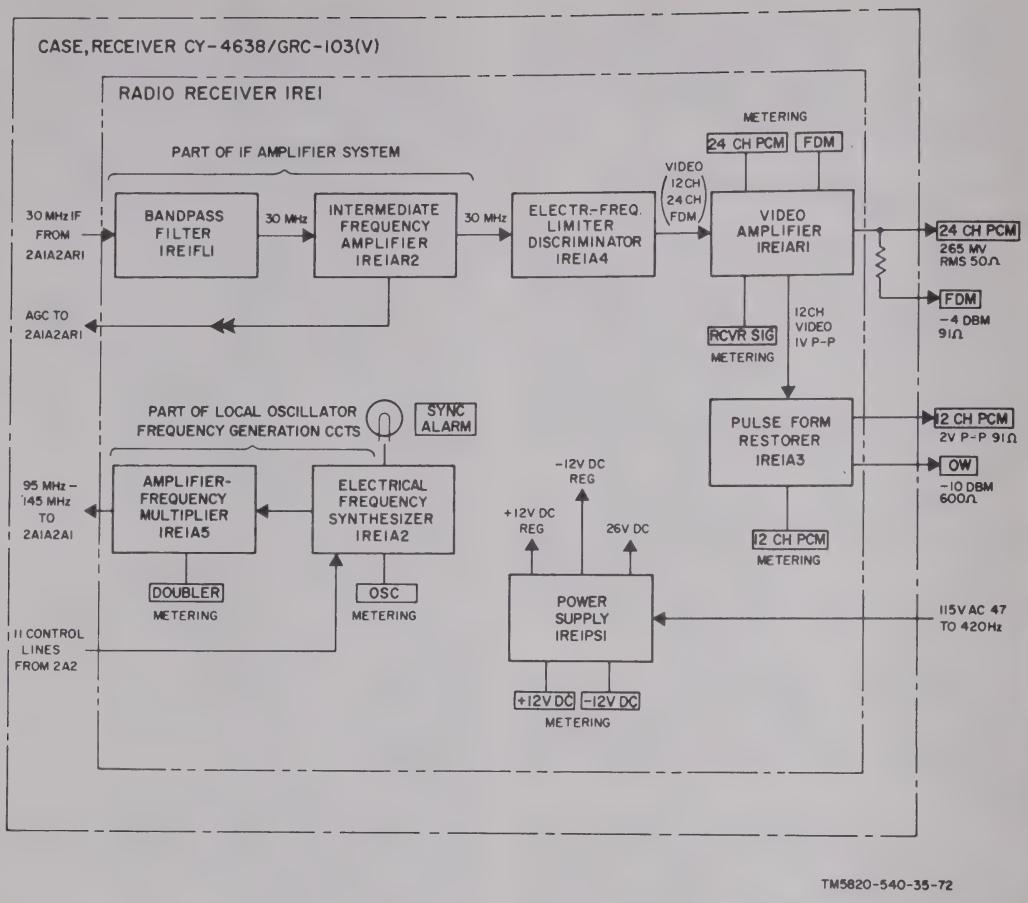


Figure 2-48. Receiver, Radio R-1329(P)/GRC-103(V), block diagram.

the receiver case FDM connector. The video amplifier also monitors the baseband signals for noise content and provides squelch of regenerated pcm or fdm video when the noise content indicates that the received signal is below the minimum operating level. In addition, the amplifier provides metering facilities for 24 CH PCM, FDM, and RCVR SIG levels.

d. Pulse form restorer 1RE1A3 reshapes the distorted pulses in the pcm pulse train and passes them onto the multiplex equipment through the squelch circuit in video amplifier 1RE1AR1. The unit also produces timing pulses at a 570-kHz bit rate, synchronized with the pcm pulse train. Recovery of the order wire signal from the combined video/order-wire signal is also done in the pulse form restorer; the recovered order wire signal is then fed through external cabling to Receiver-Transmitter, Order Wire RT-773/GRC-103(V). In addition, the pulse form restorer provides the regenerated 12 CH PCM and OW metering facilities.

e. Electrical frequency synthesizer 1RE1A2 generates the basic local oscillator frequency which is doubled in amplifier-frequency multiplier 1RE1A5. The selection of the basic local oscillator frequency is accomplished, as in the transmitter, in conjunction with the manually operated control-indicator in the receiver rf head. Control-indicator 2A2 (RCVR CHANNEL) coding is chosen so as to automatically obtain a local oscillator frequency 30 MHz above the frequency of the receive channel. The RCVR CHANNEL indicator, however, is calibrated to

indicate the frequency of the receive channel rather than the frequency of the local oscillator signal.

f. The receiver fixed head power supply, 1RE1PS1, produces the 26-volt dc non-regulated and the +12-volt dc and –12-volt dc regulated voltages required to operate the receiver fixed and rf head circuits and the order wire unit. The power supply operates from a 115-volt ac, 47-to 420-Hz source.

g. Metering facilities are provided in the receiver fixed head for the +12-volt and –12-volt dc supplies; for the output levels of electrical frequency synthesizer (OSC), amplifier-frequency multiplier (DOUBLER), frequency multiplier (MULT), antenna transmit signal level (XMTR DUPL), reflected power (REFL PWR), received signal level (RCVR SIG), regenerated pcm level (12 CH PCM), video levels (24 CH PCM and FDM), and recovered order wire output level (OW). Alarm circuits are provided to indicate a high received signal condition (HIGH SIGNAL), out-of-lock condition of the afc loop used to control the output frequency of the synthesizer (SYNC) and a high-noise condition (LOW SIGNAL).

2–41. Bandpass Filter 1RE1FL1

Bandpass filter 1RE1FL1 is a sealed unit, tuned during manufacture to produce a closely controlled gaussian frequency response with the following characteristics: 3db at ± 375 kHz and 60 db minimum at ±1,000 kHz. The insertion loss is 20 db maximum. The frequency response of bandpass filter 1RE1FL1 is shown in figure 2–49.

2–42. Intermediate Frequency Amplifier 1RE1AR2

a. General. Intermediate frequency amplifier 1RE1AR2 is similar to intermediate frequency amplifier 2A1A2AR1, being constructed by the cordwood technique. Intermediate frequency amplifier 1RE1ARV2 contains six cordwood modules, four of which are similar single-transistor amplifier stages.

b. Detailed Circuit Analysis (fig. 6–22). The 30-MHz signal from bandpass filter 1RE1FL1 at P2 is coupled through C1 to the base of the first amplifier stage, Q1, which is a fixed-gain amplifier stage to provide a stable impedance match for the output of the bandpass filter 1RE1FL1. R1 and L1 are the input terminating resistance and rf load. Bias for transistor Q1

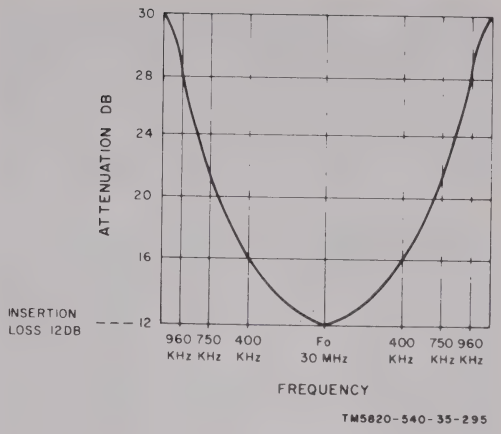


Figure 2-49. Bandpass filter 1RE1FL1, frequency response.

is derived from resistive divider R2 and R3, connected across the –12v dc supply line. The circuit uses a –12v emitter supply for more effective emitter signal decoupling at low signal level potentials. The –12v emitter supply is connected through J2 pin 3 to terminal E1 of rf detector 1RE1AR2A1 then passed in through coupling filters L2 and C1 of IF amplifiers AR5, AR4, AR3, and AR2 to coupling filter L3 and C2 of if. amplifier AR1. R5 is the collector load, matching the base impedance of the next stage. C3 is the emitter bypass, while L2 is a peaking element to provide a flat response. C5 provides filtering between the –12v supply and the agc line.

(1) The signal at the collector of Q1 is coupled through C4 to the base of Q1 in the next stage IF amplifier 1RE1AR2AR2. The second and third amplifier stages have variable bias applied to the bases of their respective transistors. The second stage circuit is similar to that of the first stage. Variable bias voltage (agc) is applied to the base of Q1 (second stage) through L4 and R6 of IF amplifier 1RE1AR2AR1 (first stage). The signal at the collector of Q1 (second stage) is coupled through C3 to the base of the third stage. Variable bias (agc) for the third stage is applied through resistor R3 of 1RE1AR–2AR2 to the base of Q1 of 1RE1AR2AR3. The fourth and fifth stages are similar fixed-gain amplifiers. Fixed bias voltage to the bases of the respective transistors is derived from the –12v dc supply through resistive divider R3 and R4. The –12v dc supply is filtered by L3 and C4 in 1RE1AR2AR3 before being

used as bias voltage. The fifth stage is the output amplifier. A collector load resistor is not required in this stage since the inherent collector output impedance (300 ohms) matches the input impedance of electrical frequency limiter-discriminator 1RE1A4. The collector output is then fed through J2 pin A1 (a coaxial connector) to 1RE1A4.

(2) A portion of this signal is fed into rf detector 1RE1AR2A1 and coupled through C1 to step-up transformer T1. The signal is stepped up by a 2:1 ratio, and rectified in peak detector, CR1, C2, CR2, and C3. The resulting dc voltage is amplified by Q1, a 2N930-type transistor with high base impedance which will not disturb the peak detecting action by drawing too much current from the detector circuit. CR3, a 5.1v Zener diode, is used to translate the –2 to –3v potential at Q1 collector to the –7 to –8v required for agc action. The agc voltage, besides being used to adjust the gain of the two intermediate frequency amplifiers 2A1A2AR1 and 1RE1AR2, is also coupled into video amplifier 1RE1AR1 where it is used for receiver signal metering (para 2–44).

2–43. Electrical Frequency Limiter-Discriminator 1RE1A4

a. General. Electrical frequency limiter-discriminator 1RE1A4 (demodulator) converts the frequency modulation information contained in the 30 MHz if. signal to a baseband signal (video), identical to the baseband signal used to modulate the synthesizer output in the remote transmitter. Like the two intermediate frequency amplifiers 2A1A2AR1 and 1RE1AR2, this unit is constructed by the cordwood principle. The 30-MHz if. input signal is frequency-modulated at 75 kHz when carrying fdm traffic, and 180 kHz or 300 kHz when carrying 12- or 24-channel pcm traffic respectively. Order wire signal deviation at 45 kHz may be present with or without any of these types of video traffic. The output of the demodulator will be a video signal at 27 mv rms for fdm traffic, and 53 mv rms or 106 mv rms for 12- and 24-channel pcm traffic. The order wire signal is contained in the video signal.

b. Block Diagram Analysis (fig. 2–50). The 30-MHz IF signal at –3 dbm from the intermediate frequency amplifier 1RE1AR2 is amplitude-limited in two amplifier/limiter stages to insure that amplitude variations will not affect the demodulated output signal. These stages are similar to the fixed-gain amplifier stages in intermediate frequency amplifier 2A1A2AR1 or 1RE1AR2 (para 2–42), with an additional limiting diode in each collector circuit. The next stage is an amplifier feeding the primary of a tuned high-tuned low discriminator-transformer. The two secondary windings are tuned 2.5 MHz above and 2.5 MHz below 30 MHz. The two transformer outputs are then rectified to reproduce baseband signals. These signals are then fed through an emitter-follower stage which will prevent the video amplifier 1RE1AR1 circuits from loading the discriminator circuits. A LEVEL potentiometer in series with the output signal permits adjustment of the output level.

c. Detailed Circuit Analysis (fig. 6–23). The 30 MHz IF signal is fed through connector A1 to the electrical noise limiter 1RE1A4A3 module and coupled through C2 to the base of Q1. Bias for Q1 is derived from the –12v dc line through resistive divider R2 and R3. Similar to intermediate frequency amplifiers 1RE1AR2 and 2A1A2AR1, –12v dc is used as emitter supply (rather than +12v collector supply) because emitter signal decoupling is more effective at a lower signal level. C1 and L3 provide rf filtering

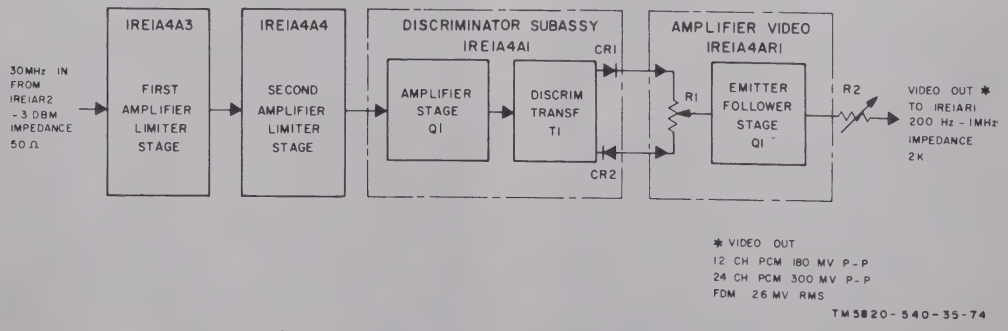


Figure 2-50. Electrical frequency limiter discriminator 1RE1A4, block diagram.

of the –12v dc supply. L1 is the rf load in the base circuit and L2 is the rf load in the collector circuit. R1 serves to match the base impedance of Q1 to the output impedance of the main IF amplifier. CR1 limits the level of the signal at Q1 collector. C3 is the emitter bypass. The signal at the collector of Q1 is then coupled through C4 to the base of Q1 of electrical noise limiter 1RE1A4A4. Bias for Q1 of 1RE1A4A4 is obtained from the resistive divider R6, R7 in RE1-A4A3. The operation of 1RE1A4A4 stage is identical to that of 1RE1A4A3. The output of the second amplifier/limiter stage is then coupled through C3 to the base of Q1, the discriminator divider-amplifier in the discriminator subassembly 1RE1A4A1.

(1) Bias for Q1 is obtained from –12v dc through resistive divider R3, R4 in 1RE1A4A3. The primary winding of the discriminator transformer T1, together with C4 and C1 in capacitor assembly 1RE1A4A5, form a tuned circuit centered on 30 MHz with a flat response around the midband. The tuned center frequency is adjusted by C1 in 1RE1A4A5. The two secondary windings of T1, together with capacitors in 1RE1A4A5, form two tuned circuits, one centered on 27.5 MHz (C2 and C5) and the other on 32.5 MHz (C3 and C6). These circuits are adjusted by C2 and C3 respectively. R3 and R4 in discriminator subassembly 1RE1A4A1 provide unequal damping of the secondary tuned circuits in the correct ratio to equalize the output voltages, as the frequency is shifted above and below the center frequency.

(2) The output voltages from the secondary tuned circuits are rectified by CR1 and CR2 before they are combined in R1 of video amplifier 1RE1A4AR1. The demodulated signal is then coupled through C1 to the base of emitter-follower Q1. R1 in the output stage is adjusted to supply zero volts to the base of emitter-follower Q1 at 30 MHz, and positive or negative voltage as the incoming frequency shifts above or below 30 MHz. The output at the emitter of Q1 is then coupled through C2 to level control R2 and then to A1, the output connector. The emitter follower is used to isolate the limiter-discriminator circuits from those of the video amplifier 1RE1AR1.

2–44. Video Amplifier 1RE1AR1

a. General. Video amplifier 1RE1AR1 provides the last stage of amplification of the received signal and controls the level and the frequency response of the video (baseband) signal. The demodulated signal from electrical frequency limiter-discriminator 1RE1A4 contains both video and order wire signals. The video signal is either 12- or 24-channel pcm traffic or fdm traffic, depending upon the system requirements. Order wire separation takes place in pulse form restorer 1RE1A3 for both 12-channel pcm and fdm traffic; order wire separation takes place in the combiner for 24-channel traffic. In addition, video amplifier 1RE1AR1 produces a dc metering voltage to indicate the level of the fdm or 24-channel pcm video used for system line-up, and a dc metering voltage (derived from the agc voltage) to indicate the received signal level. The 12-channel pcm video output is then fed into pulse form restorer 1RE1A3 for pcm regeneration and order wire separation. Fdm and 24-channel pcm video outputs are connected to the FDM or VIDEO connectors at the rear of the case through a resistive divider mounted in the receiver case.

b. Block Diagram Analysis (fig. 2–51). The input to video amplifier 1RE1AR1 can be either 12-channel pcm at 180 mv peak-to-peak, 24-channel pcm at 300 mc peak-to-peak, or fdm at 26 mv rms, depending on the type of traffic in use. The incoming signals from electrical frequency limiter-discriminator 1RE1A4 are coupled through a potentiometer and buffer amplifier Q1 to low pass filter FL1. The potentiometer adjusts the level of the incoming signals applied to the buffer amplifier. The buffer amplifier provides impedance matching between electrical frequency limiter-discriminator 1RE1A4 and the low pass filter. The FL1 low pass filter shapes the video signals in a gaussian response curve which is 3 db down at 400 kHz and 17.5 db down at 960 kHz. The signal at the output of the filter is then amplified in a three-stage cascade amplifier Q2, Q3, Q4 with an emitter-follower output stage. Overall feedback extends the amplifier frequency response to about 5 MHz to insure that all response shaping is accomplished in low pass filter FL1. The gain of the amplifier is 100. The output of the emitter-follower is applied to a cascade emitter-follower stage, Q5 and Q6, which produces a high-level output signal into a low impedance load.

(1) The signal at the output of the cascade emitter-follower stage is distributed as follows:

(*a*) To the receiver case for connection to the VIDEO and FDM output connectors for distribution to multiplex equipment.

(*b*) To pulse form restorer 1RE1A3

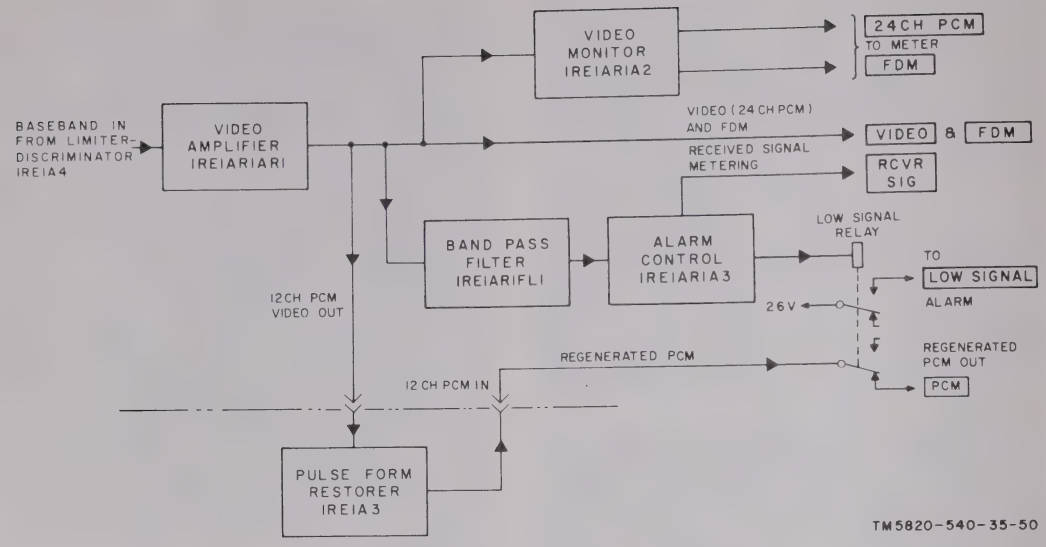


Figure 2-51. Video amplifier 1RE1AR1, block diagram.

for PCM regeneration and order wire recovery.

(*c*) Through high pass filter 1RE1AR1–FL1 to alarm control 1RE1AR1A3 for noise monitoring.

(*d*) To video monitor 1RE1AR1A2 for video signal metering.

(2) The video signal at the output of Q5–Q6 is coupled through a potentiometer to the buffer amplifier in 1RE1AR1FL1 which provides impedance matching between the wideband amplifier and the high pass filter. The potentiometer is used to adjust the operating point of the low signal alarm circuit. High pass filter FL1 selects a band of high-frequency noise in the range of 520 kHz to 2 MHz and attenuates all frequencies below 500 kHz. The noise signal is then amplified in a three-stage cascade amplifier, Q1, Q2, and Q3 (with a gain of 100) to a level suitable for noise monitoring. The amplified noise signal is then fed to wideband transformer T1 and a bridge rectifier CR1 through CR4. The dc output of the bridge rectifier is used to control Schmitt trigger circuit Q4,–Q5 with a snap action, turn-on turn-off operation The Schmitt trigger circuit is used to control the current through the low signal alarm relay.

(3) During normal operating condition, the relay is de-energized and the regenerated pcm signal from pulse form restorer 1RE1A3 is routed through a pair of normally-closed contacts to the pcm output connector on the receiver case. Under high noise conditions the relay is energized and squelches the regenerated pcm while another pair of contacts provides the LOW SIGNAL alarm.

(4) The video signal for metering is amplified in a two-stage amplifier, Q1 and Q2, then rectified by CR1 and CR2 to produce a dc signal suitable for metering the 24-channel pcm and fdm signal levels. Series thermistors provide temperature compensation. The signal is then made available through separate meter calibrating resistors to the 24 CH PCM and FDM metering positions. A separate metering circuit select a portion of the agc voltage from 1RE1AR2 (through 1RE1A4) and applies it to the meter in the RCVR SIG position.

c. Detailed Circuit Analysis (fig. 6–24). The incoming video signal is connected through J1 pin A1 to terminal E1 of video amplifier 1RE1AR1AR1, then through R1 to the base of buffer amplifier Q1. R1 adjusts the level of the input signal to the base of Q1. The output at the collector of Q1 is then coupled through C3 to low pass filter FL1 for final shaping. The output of the filter is amplified in Q2 and Q3, then applied to the base of emitter follower Q4. C8 prevents any tendency for spurious oscillation in Q2. The output at the emitter of Q4 is connected to the base of Q5; Q5 and Q6 are connected as a cascade emitter-follower across the +12v and –12v dc lines such that their output signal can be nearly 12v peak-to-peak, if required, into a very

low impedance lead. This output signal is then coupled through C13 directly to high pass filter 1RE1AR1FL1 and video monitor 1RE1AR1A2. A portion of the output signal is fed through R15 and P1–9 to pulse form restorer 1RE1A3 and through R17 and P1–24 to receiver case 1A2. Negative feedback taken from the output signal is coupled through R9 and C7 to the emitter of Q2.

(1) The signal fed into high pass filter 1RE1AR1FL1 is applied through R1 to the base of Q1, which operates as a buffer amplifier to match the output signal to bandpass filter FL1. FL1 selects the noise components lying between 520 kHz and 2 MHz. This noise is then fed directly to the base of Q1 of alarm control 1RE1AR1A3. Q1, Q2 and Q3 amplify the noise signal and apply it to the primary winding 3–4 of broadband transformer T1. Negative feedback from the Q3 emitter is coupled through R7 and C3 to the emitter of Q1 to stabilize the amplifier gain and extend the frequency response. The output at the secondary winding 1–2 of T1 is fed to bridge rectifier CR1 through CR4, and the resultant dc voltage, proportional to the noise level, is then connected to the base of Q5. Normally Q5 base is held at about –0.6v by CR5 and R10 and Q5 is therefore cut-off. When the voltage at the rectifier output raises this voltage to +0.7v, Q5 starts to conduct. This causes the base of Q4, a PNP transistor, to go negative and drive it into conduction. Q4 emitter-collector current flows through low signal alarm relay K1, causing it to operate. When K1 is energized, 26v dc at P1–3 is connected to the LOW SIGNAL alarm lamp on the front panel; at the same time another pair of relay contacts breaks the regenerated pcm output path, terminating the regenerated pcm output signal into 91-ohm resistor R17. CR7 is a protection diode for Q4. Unstable or intermittent operation of Q1 is prevented, since the noise-generated dc signal at the output of CR1 through CR4 has to overcome a bias voltage.

(2) The input at video monitor 1RE1AR1A2 is coupled through C1 to the base of Q1 amplifier. The amplified signal at the collector of Q1 is applied directly to the base of emitter-follower Q2. The signal at the emitter of Q2 is applied to a voltage doubler rectifier circuit: C3, CR1, CR2, C4, and R5; L1 prevents spurious oscillations in Q2. The resulting dc signal is fed through thermistors R10 and R11 which stabilize the metering circuit against temperature variations. R7 and R9 adjust the level of the 23-channel pcm signal metering voltage; R6 and R8 adjust the level of the fdm signal metering voltage.

(3) Receiver signal metering voltage (RCVR SIG) is derived from voltage divider R14, R15, R16, and CR6, connected across the –12v dc supply and ground. This voltage is applied to the positive side of the front panel meter in the RCVR SIG position while the agc voltage, filtered by L2 and C14 in video amplifier 1RE1AR1AR1, is applied to the negative side. This arrangement is necessary because the agc voltage is negative and directly proportional to the received signal level.

2–45. Pulse Form Restorer 1RE1A3

a. General. Since the original 12-channel pcm pulse train suffers a certain amount of distortion during transmission over the radio system, the pulses must be regenerated to their ideal shape in order to obtain a distortion-free signal at the multiplex equipment. Pulse form restorer 1RE1A3 performs the following major functions:

(1) Generates timing pulses to re-time the relative pulse positions, and synchronize the multiplex to pulse form restorer 1RE1A3.

(2) Regenerates the original distorted pulses and forms new pulses, perfectly square and free from noise.

(3) Recovers the order wire signal from the combined order wire and pcm video signal.

(*a*) Pulse form restorer 1RE1A3 is not used when the AN/GRC–103 is carrying 24-channel pcm traffic, its functions being taken over by an external 24-channel combiner. The recovered order wire signal however is brought back into the pulse form restorer for distribution to the order wire unit.

(*b*) Order wire recovery also takes place in the pulse form restorer when the AN/GRC–103 is carrying fdm traffic.

b. Block Diagram Analysis (fig. 6–25). The input to pulse form restorer 1RE1A3 is the composite order wire/pcm signal from video amplifier 1RE1AR1, a 1.0-volt peak-to-peak train of gaussian-filtered video pulses riding upon an order wire signal of 0.25 volt peak-to-peak. The pcm video train is not modulated with the order wire signal; the pulse train baseline and peak voltages vary simultaneously at the audio rate of the order wire signal.

(1) This input signal is applied first to two-stage amplifier Q1 and Q2 of electrical synchronizer 1RE1A3A3 having an emitter-follower output. Here the signal is split, one output being fed to the clamp circuit, CR1 and CR2, and the other to a 150-kHz low pass filter of the order wire

recovery circuits, (modulation eliminator 1RE1A-3A1). The double-diode clamp circuit sets up a reference dc voltage at the base of input transistor Q3 of the amplifier/slicer circuit. This is done to remove the order wire component from the signal and to permit slicer triggering near the center of each pcm pulse.

(2) Differential amplifier slicer circuit Q3 and Q6 slices the pcm pulse train, amplifying a small portion of each pcm pulse to sharpen the leading and trailing edges. The SLICER LEVEL control at the base of the second half of the slicer is adjusted to a point on the pulse near the triggered operating point of the input side to insure that only a small portion of each pulse is amplified in the differential amplifier Q4 and Q5. The differential amplifier produces two antiphase outputs. The two antiphase outputs are split; one pair is fed to the differentiators/adder circuit and the other pair is fed to the dual gate Q5, Q2 in pulse form restorer 1RE1A3A2.

(3) The two antiphase pcm trains from the differential amplifier are applied through two differentiators to adder circuit CR3 and CR4. One differentiator produces a sharp spike at each transition of the upright pcm signal and the other produces a spike at each transition of the inverted pcm signal. The adder diodes then remove the positive-going spikes, leaving acombined train of negative spikes, each spike representing a transition of the incoming pcm signal. These spikes are then applied to one side of bistable multivibrator Q7 and Q8. The multivibrator is alternately triggered by spikes from the adder circuit and by negative spikes from timing oscillator circuit Q8 and Q9, of pulse from restorer 1RE1A3A2. The output from the multivibrator is a train of square wave pulses at twice the frequency of the incoming pcm pulses. The width of these pulses represents the relative phase of the basic incoming pcm pulse rate and the timing oscillator frequency. These pulses are then fed through amplifier Q9 and an integrator circuit which will generate sawtooth pulses whose amplitude will depend upon pulse width and, therefore, upon the relative phase of the incoming pcm rate and the timing oscillator frequency.

(4) The sawtooth pulses are peak detected to produce a dc signal which very nearly equals the peak voltage of the sawtooth. The resulting voltage is then amplified in differential dc amplifier Q10 and Q11 in pulse form restorer 1RE1A3A2 before being applied to control varactor CR5 in the timing oscillator circuit.

(5) The timing oscillator consists of a free-running multivibrator, Q8 and Q9, which has a crystal and varactor in series in the feedback loop. The crystal Y1 frequency is 575.9 kHz; the varactor is used to pull its frequency to a nominal 576 kHz. The dc controlling voltage produced from the incoming pulse train is then used to control the timing oscillator over narrow limits (about 40 Hz) and lock it to the pulse rate of the incoming pcm. One output of the timing oscillator is fed through a differentiator to bistable multivibrator Q7 and Q8 of electrical synchronizer 1RE1A3A3 in the frequency control loop. A second output is fed through a differentiator to timing output amplifier Q7.

(6) The spike output of the oscillator is fed through a two-stage amplifier, Q7 and Q6, which removes the negative spikes produced in the oscillator, and adjusts the level of the positive-going spikes to 2.0 volt. Output stage Q6 is an emitter-follower to match the output source impedance to the 91 ohm load. A second output is taken from the first stage of the output amplifier to dual gate Q5 and Q2.

(7) The timing pulses will pass through the dual gate in the presence of antiphase pcm signals. Thus, one timing pulse will pass through one side of the gate in the presence of each incoming positive pcm pulse, and one will pass through the other side of the gate in the presence of each incoming negative pcm pulse. The two outputs of the dual gate are fed to gated multivibrator Q3 and Q4.

(8) The positive-going timing pulses through the dual gate are used to trigger the multivibrator to produce the regenerated pcm signal. The output of the multivibrator consists of pulses whose leading edges correspond to the leading edge of the first timing pulse in the presence of a pcm pulse and whose trailing edges correspond to the leading edge of the first timing pulse to occur when no pcm is present. The regenerated pcm is delayed by approximately 1/2-bit but has none of the distortion and noise of the received pcm video. The multivibrator produces two antiphase outputs. One output is amplified in Q1 and the resulting 2.0 volts peak-to-peak pulse in a 91-ohm load is fed to the pcm output connector. The other output is fed to the order wire recovery circuits in modulation eliminator 1RE1A3A1. This output also feeds a pcm level metering circuit. When the AN/GRC-103 is used in the fdm mode, the timing oscillator runs free, producing timing pulses which could cause noise on order wire or fdm channels. The timing pulses are inhibited by Zener diode CR7

connected in a voltage divider between the –12-volt dc supply and ground. One resistor in the voltage divider is the external 91-ohm terminating resistance. When the 91-ohm load is not connected, due to the radio set being connected to operate in the fdm mode or the 24-channel pcm mode, the -12-volt dc is fed back through the 6.8v Zener to timing output amplifier Q7, cutting it off. This action also prevents the pcm regenerator gate and gated multivibrator from operating.

(9) The order wire recovery circuits are contained in modulation eliminator 1RE1A3A1. The second regenerated pcm output of the gated multivibrator is fed to buffer amplifier Q1. The incoming composite signal (inverted in amplifier Q1 and Q2 in electrical synchronizer 1RE1A3A2) is fed to a 150-kHz low pass filter, R2, C3 and L1, and emitter-follower Q2. This signal is applied to positive and negative peak detectors CR1 and CR2, and then to antiphase limiter Q3 and Q4. Q3 and Q4 limit the level of the regenerated pcm signal to equal the level of the pcm pulses of the incoming composite signal. The composite signal is applied to one side of cancellation potentiometer R11, and the level controlled regenerated pcm is fed to the other side. When this PCM CANCEL control is correctly adjusted, the two antiphase signals cancel, leaving only the order wire component to be fed to order wire amplifier Q6.

(10) An equalizer, C10, R12, and R24, introduces a controlled amount of distortion in the regenerated pcm signal, equal to the distortion present in the incoming pcm signal. The amount of delay introduced is adjusted by OW NOISE control R24.

(11) The output of the order wire amplifier is fed through a 3-kHz low pass filter, C12 and L5. The output of the low pass filter is split; one output is fed through order wire relay contacts K1 to the OW output connector, the other is fed to the order wire metering circuit, Q7, CR3, and CR4.

(12) When the AN/GRC–103 is operating in the fdm mode, it is possible for the slicer to trigger on modulation peaks and generate noise which could interfere with the fdm or order wire channels. To prevent this, the voltage at the negative peak detector is used to turn on control transistor Q5, which then clamps one side of slicer circuit Q6 in electrical synchronizer 1RE1A3A3. The control transistor will be turned on, since there will be no incoming signal to generate a negative voltage at the peak detector. Clamping of the slicer circuit in this manner will prevent the amplification of any spurious input signals.

c. Detailed Circuit Analysis (fig. 6–26). The composite order wire/pcm signal from P1–7 is fed into electrical synchronizer 1RE1A3A3 and coupled through C1 to the base of Q1. The amplified signal at Q1 collector is connected directly to the base of Q2, an emitter-follower. The output signal from Q2 is split, one output being used for pcm regeneration, the other for order wire recovery. The output used for the recovery of the order wire is fed through E4 to terminal E3 of modulation eliminator 1RE1A3A1. The output used for pcm regeneration is coupled through C2 to double-diode clamp circuit CR1, C3, R6, CR2, C4, and R7.

(1) C2 attenuates the order wire signals while CR1 and CR2 generate positive and negative dc voltages at C3 and C4 respectively. These voltages will be equal if the peak positive and negative excursions of the pcm at Q3 base are equal, relative to the zero-volt line. If the positive excursions are greater than the negative excursions, the voltage across R6 will be greater than the voltage across R7. Since R6 and R7 are of equal resistance, this will cause a net positive current to flow out of C2, causing the dc voltage at Q3 base to change until the positive and negative voltage excursions relative to ground are equal.

(2) Transistor pairs Q3 and Q4, and Q6 and Q5 are connected in the *alpha* configuration, in which each pair can be considered as a single very high-gain transistor. These transistor pairs are connected at their emitters to a single resistor R10, the whole circuit operating as a differential dc amplifier.

(3) The pcm signal applied to Q3 base is centered at zero volts dc by the clamp circuit. The differential amplifier, or slicer response is also centered at zero volts dc by adjustment of SLICER LEVEL control R13; this eliminates the circuit imbalance due to the tolerances of base/emitter voltages of Q3, Q4, Q5 and Q6. The outputs at E5 and E6 are each an amplification of the voltage difference between the Q3 base and the Q6 base. Since the pcm input at the Q3 base is much greater than the input range of the slicer circuit, the signals at the Q4 and Q5 collectors are squared-up versions of the input pulses. The signals at the Q4 and Q5 collectors are antiphase pcm trains. Each has two outputs, one pair of outputs going through Q5 and E6 to pcm regeneration circuits on pulse form re-

storer 1RE1A3A2, and the other pair of outputs going to two differentiator circuits. The differentiators, C5 and R15, and C6 and R16, produce spikes at each transition of the pulses. CR3 and CR4 then clip off the positive spikes, leaving a train of negative-going spikes at their common output. Each spike represents one transistion of the incoming pcm signal.

(4) These negative spikes are applied to the base of Q7, one half of a bistable multivibrator. Negative timing pulses from the timing oscillator in pulse form restorer 1RE1A3A2 are applied to the base of Q8, the other half of the multivibrator. Triggering of the multivibrator in this manner produces a train of pulses at the Q8 collector whose leading edges correspond to zero crossing of the original pcm pulses and whose trailing edges correspond to zero crossings of the timing oscillator pulses.

(5) The pulse rate is twice the pulse rate of the original pcm train; the pulse width is a function of the difference in time between the zero crossing of the pcm train, and the zero crossing of the next timing pulse. The signal at the collector of Q8 is applied through R24 to the base of amplifier Q9; the collector output of Q9 is fed to an integrator circuit, R26, R27, and C7, which converts the video pulses into sawtooth shape pulses. The peak amplitude of these pulses is proportional to the width of video pulses and therefore is a function of the difference in frequency between pcm pulses and timing oscillator pulses. PCM SYNC control R26 adjusts the nominal sawtooth peak voltage to synchronize the timing oscillator to the pcm signal. The sawtooth voltage is then fed to the base of Q10; R28 and C8, a peak detector circuit at the emitter of Q10, produces a dc voltage whose level is a function of the amplitude of the sawtooth signal applied to the Q10 base. The time constant of R28 and C8 is sufficiently long for very little change in dc voltage to take place even in relatively long periods between incoming pcm pulses. This dc voltage is connected through E10 to E9 of pulse form restorer 1RE1A3A2 and applied to the base of Q11. Q11 and Q10 form an emitter-coupled dc amplifier. Reference voltage applied to the base of Q10 is derived from the +12v line by voltage divider R27 and R28. The input voltage to the base of Q11 is a function of the difference in phase of the timing oscillator with respect to the zero crossings of the pcm video train. The output dc voltage at the Q10 collector is filtered by C11, L3, and L2, and then used to control the capacity of varactor CR5 in the timing oscillator circuit. CR5 is in series with 575.9-kHz crystal Y1. These two components form the frequency controlling element in the feedback loop of free-running multivibrator Q8 and Q9. Normal bias on the varactor will pull the crystal frequency to a nominal 575 kHz. Any deviation from this frequency of the incoming pcm pulse rate will shift the time relation of the two signals at the bases of bistable multivibrator Q7, and Q8 on electrical synchronizer 1RE1A3A3. This shift will cause a change in output pulse width and sawtooth amplitude. The change in sawtooth amplitude results in a change of dc bias on CR5. This will change CR5 capacity and pull the crystal frequency into exact phase lock with the incoming pcm pulse rate frequency. One output of the timing oscillator is differentiated in C10 and R23 in electrical synchronizer 1RE1A3A3 and passed through CR5 to the bistable multivibrator. CR5 removes the positive spikes. The resulting train of negative-going timing pulses if fed to the base of Q8 of bistable multivibrator circuit Q8 and Q7 for gating.

(6) A second output of the timing oscillator (Q9 collector) is differentiated by R26 and C8, and the train of positive and negative timing pulses is amplified in Q7.

(7) CR3 at Q7 collector removes the negative spikes, leaving the positive spikes to be passed through R19 to the base of emitter-follower Q6. The 2.0-volt peak-to-peak signal at the Q6 emitter is coupled through C6 to P1–15, the timing output connection. The second output at the Q7 collector is applied through R16 to the collectors of a dual gate consisting of Q2 and Q5.

(8) The shaped antiphase pcm pulse trains at the collectors of amplifier-slicer Q4 and Q5 in electrical synchronizer 1RE1A3A3 are applied through R14 and R6 to the bases of dual gate circuit Q2 and Q5 in pulse form restorer 1RE1A3A2. Q2 and Q5 operate in conjunction with Q3 and Q4 bistable multivibrator in which the actual pcm regeneration takes place. The train of positive-going timing pulses derived from the timing oscillator is applied through R16 simultaneously to the collectors of Q2 and Q5. Q5 and Q2 are so biased that each transistor will conduct a timing pulse when the pcm at Q3 is negative or positive respectively. The sliced pcm pulses applied to the base of Q5 make Q5 conduct for the duration of the pcm pulse. The first positive timing pulse appearing at the emitter of Q5 (Q5 conducting), switches Q2 on and simultaneously, by multivibrator action, switches Q3

off. A positive pulse, for the duration of the pcm pulse and delayed by 1/2-bit, appears at the collector of Q3. Q2 stays switched off until a positive pulse appears at the base of Q2 making Q2 conduct. The first positive timing pulse to appear at the emitter of Q2 switches Q3 on and simultaneously switches Q4 off. A positive pulse appears at the collector of Q4, delayed by 1/2-bit, and remains positive for the duration of the interval between pcm pulses, or until the next positive-going timing pulse at the emitter of Q5 switches Q3 off. The action continues in this manner regenerating a train of pulses which represents the incoming pcm train. This new pulse train will be delayed by one-half pulse but since it is synchronized by the timing output pulses the delay has no effect on multiplexer operation. Inverted regenerated pcm pulses are fed from the Q4 collector through R4 to the base of output amplifier Q1. The signal at the Q1 collector, –2v peak-to-peak in 91 ohms, is connected through E2 to P1–13. Upright regenerated pcm pulses from the Q3 collector are fed through R5 and C2 to a metering detector, CR1 and CR2. The rectified dc is fed through R1 and E11 to P1–9. A second output from the Q3 collector is connected through E5 to the order wire recovery circuits on modulation eliminator 1RE1A3A1.

(9) A 6.8v Zener diode CR7 provides protection against spurious operation during the fdm mode of operation, which could cause noise to be induced into order wire circuits. In normal pcm operation, a 91-ohm termination resistor is externally connected between P1–13 and ground. This resistor, along with R2, forms a voltage divider between –12 volts and ground. The voltage at the CR7 cathode is not high enough to fire the Zener. In the fdm or 24-channel pcm modes of operation, however, the external termination is not connected, so the CR7 cathode rises to about –12 volts. The Zener passes about 5.2 volts through L1 to the Q7 collector, effectively removing all timing pulses. The absence of timing pulses at the collectors of the Q2–Q5 gate circuit causes gated multivibrator Q3 and Q4 to be inoperative.

(10) The order wire circuits on modulation eliminator 1RE1A3A1 perform their functions by cancellation of the pcm pulses within the composite signal. The inverted composite signal (amplified) at the Q2 emitter of electrical synchronizer 1RE1A3A3 is fed through E4 to E3 in modulation eliminator 1RE1A3A1 and applied through R2 to low pass filter L1 and C3. This filter removes all high frequency noise components above 150 kHz and single bits of pcm of the composite order wire/pcm input signal before being applied in the base of Q2. Q2 passes the order wire/pcm composite signal at an impedance level suitable for peak detection and pcm cancellation, and also prevents peak detector voltages from getting into the low pass filter circuit. The output at the Q2 emitter is coupled through L4, C5, and R10 to one side of PCM CANCEL potentiometer R11. The composite signal at the Q2 emitter is also coupled through C6 to positive peak detector CR1, C7, and R4, and to negative peak detector CR2, C9, and R6. CR1 and C7 clamp the base voltage of Q3 to a peak positive pcm signal level; CR2 and C9 clamp the base voltage of Q4 to a peak negative pcm signal level.

(11) Upright regenerated pcm from the collector output of Q3 (pulse form restorer 1RE1A3A2) is brought in through E2 and applied to the base of emitter-follower Q1. The output of Q1 is then coupled through C2 to the emitters of Q3 and Q4 which effectively clamp the level of the regenerated pcm to the level of the composite pcm pulse amplitude. The level controlled regenerated pcm is then coupled through C10 to the other side of PCM CANCEL potentiometer R11. When resistor R11 is correctly adjusted, the two opposite pcm signals will cancel, leaving only order wire signal components. C10, R12, and R24 form a phase-shifting network that introduces a low-frequency phase shift into the regenerated pcm equal to that introduced by the system. This technique eliminates any order wire noise component caused by an unequal low-frequency phase shift. R24, the OW NOISE control, adjusts the amount of shift required to equalize the delay in the incoming signal.

(12) The level of the order wire signal is adjusted by OW GAIN resistor R13, before being amplified by amplifier Q6. C11 attenuates any remaining high frequency components in the order wire signal. The amplified signal at the Q6 collector passes through 3-kHz low pass filter L5, and C12 to E10 and relay contacts A3–A2 to P1–14 for connection to the order wire unit. Some of the signal from L5 is applied through R17 to the base of Q7. The amplified signal at Q7 collector is connected through C14 to metering detector circuit CR3 and CR4. The resulting dc is then connected through R23 and E9 to P1–10.

(13) When the AN/GRC–103(V) operates in the fdm mode, the order wire signals are passed through the path of the composite order wire/

pcm signal, passing through low pass filter C3 and L1, amplifier Q2, and one side of the PCM CANCEL potentiometer to amplifier Q6 and so on.

(14) In the fdm mode of operation it is essential that the pcm regenerator be squelched, since there is no incoming pcm to cancel the regenerated pulses which could be caused by noise peaks triggering the slicer. In the 12-channel pcm mode of operation, Q5 in modulation eliminator 1RE1A3A1 is held at cut-off by the negative peak detector voltage on its base and so it has no effect on Q6 in the amplifier slicer circuit in electrical synchronizer 1RE1A3A3. With no incoming pcm this bias is removed, permitting it to conduct and cause a drop in voltage at the Q6 base. This cuts off Q6, in turn cutting off Q5 and Q4, and prevents the amplifier circuit from operating.

(15) When the system is carrying 24-channel pcm, the order wire recovery takes place in the combiner unit. The recovered order wire signal, at a level of 4 dbm, is applied to E7 from P1–3. A signal from the multiplex combiner unit is connected through P1–24 to K1, energizing it. This signal is attenuated 6 db in R21 and R22 and then connected through K1–A1 and A2 to P1–14.

(16) The recovered order wire signal at a level of –4 dbm is connected through P1–3 and E7 to attenuator R21 and R22. A signal from the multiplex combiner unit is connected through P1–24 to order wire relay K1 energizing it. The order wire signal, now at –10 dbm, is connected through A1 and A2 contacts of K1 to P1–14 for connection to the order wire unit.

2–46. Local Oscillator Frequency Generating Chain

a. General. The local oscillator frequency is generated and doubled in the receiver fixed head then fed to the receiver rf head where it is multiplied to its final frequency. Local oscillator frequency selection is determined by control-indicator 2A2, located in the receiver rf head. The basic frequency is generated in electrical frequency synthesizer 1RE1A2, depending on the coding information received from control-indicator 2A2. The output of the electrical frequency synthesizer is doubled in amplifier-frequency multiplier 1RE1A5 and then applied to frequency multiplier 2A1A2A1 in the receiver rf head, where it is doubled or tripled as required. Final control of the local oscillator frequency is exercised by tunable bandpass filter assembly 2A1A2A3, before it is applied to frequency mixer stage 2A1A2A2.

b. Block Diagram Analysis (fig. 2–52). Electrical frequency synthesizer 1RE1A2, in conjunction with control-indicator 2A2, generates selected frequencies in the range of 47.5 to 72.5 MHz. Each of the selected frequency steps is referenced to a crystal-controlled oscillator to provide the required frequency stability. The local oscillator multiplication factor is times-4 for channel 119 and below and times–6 at channel 120 and above. The channel selector provides a 10-digit binary code to the synthesizer to select the correct basic frequency. An eleventh digit (control line 13) is generated between channels 119 and 120 to change the frequency steps of the synthesizer output from 125 kHz (times–4 multiplication) to 83.33 kHz (times–6 multiplication). The decade counter of control-indicator 2A2 within the front panel is offset by 60 channels in the cam coding arrangement. Thus the frequency of the local oscillator is 30 MHz higher than the frequency of the received channel as indicated on the front panel. The 47.5 to 72.5 MHz output of the synthesizer is fed into amplifier-frequency multiplier 1RE1A5 which doubles the synthesizer output frequency and amplifies the resulting signal to the level required by the subsequent multipliers in the receiver local oscillator frequency generating chain. The output rf signal, 95 to 145 MHz at +15 dbm ±2 db, is then fed into frequency multiplier 2A1A2A1, located in the receiver rf head, which provides the final frequency multiplication. Frequency multiplier 2A–1A2A1 doubles the incoming rf frequency over a portion of the band and triples it over the remainder of the band (para 2–35).

2–47. Amplifier-Frequency Multiplier 1RE1A5

a. General. Amplifier-frequency multiplier 1RE1A5 is functionally similar to amplifier-frequency multiplier 1TR1A4 (para 2–16), but they are not interchangeable.

b. Block Diagram Analysis (fig. 2–53). Electrical frequency synthesizer 1RE1A2 output, in the range of 47.5 to 72.5 MHz at a nominal level of +16 dbm (at 47.5 MHz) to 12 dbm (at 72.5 MHz), is first fed to low pass filter 1RE1A5FL1. The low pass filter attenuates all unwanted harmonics generated by electrical frequency synthesizer 1RE1A2 which would otherwise lower the efficiency of the doubler circuit. The rf signal at the output of the filter is applied to 4-to-1 transformer T1 in amplifier-frequency multiplier 1RE1A5A1. T1 converts the unbalanced input

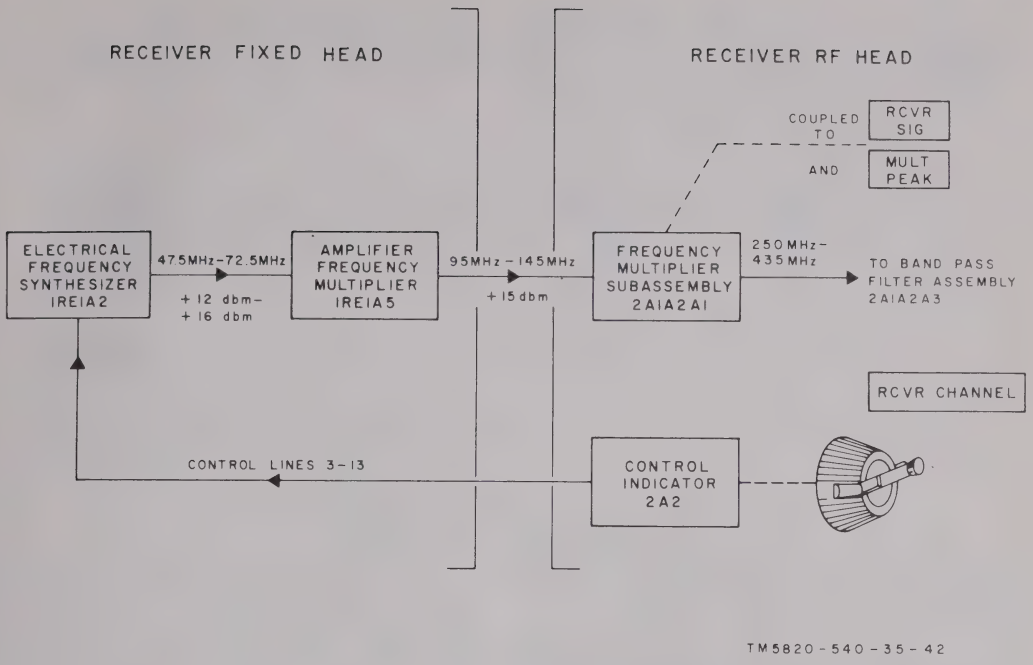


Figure 2-52. Local oscillator frequency generation, block diagram.

line to a balanced output which is then fed into full-wave rectifier CR1. CR1 consists of a matched pair of hot carrier diodes. Hot carrier diodes provide efficient frequency doubling with low spurious output. The rectifier output circuits are balanced to remove the fundamental input frequency and all odd harmonics. Total conversion loss is about 8 db; the resulting signal is applied to three-stage, stagger-tuned, broadband amplifier Q1 through Q3. The first stage is tuned at the low end of the frequency range, while the second stage is tuned at the high end of the frequency range; the third stage is tuned at mid-frequency. Amplifier gain is fixed at about 10 db. The output of the amplifier is then coupled to a tuned bandpass filter which attenuates all unwanted harmonics. The output signal in the range of 95 to 145 MHz in 50 ohms is fed to frequency multiplier 2A1A2A1 in the receiver rf head. A dc metering signal, derived from the output signal, provides an indication of the actual power delivered to frequency multiplier 2A1A2A1 (DOUBLER metering).

c. Detailed Circuit Analysis (fig. 6-27). The incoming signal is fed through P1-A1 to low pass filter 1RE1A5FL1, a conventional 1C-type filter mounted on a separate board. The unbalanced output of the filter is connected across terminals E2 and E1 of amplifier-frequency multiplier 1RE1A5A1, then to terminals 1 and 2 of transformer T1. The output at pins 3 and 5 is balanced to ground and stepped up in voltage four times to increase the efficiency of full-wave rectifier CR1, L1, R1, and C3, and L2, R2, and C4, balanced tuning circuits, eliminate the fundamental frequency and all odd harmonics of the fundamental. Balance of the two sides of the rectifier output is achieved by adjusting R1 and R2, the HARMONIC REJECT potentiometers The output of the rectifier, at twice the input frequency, is then coupled through C1, C2, C5, and L3 to the base of Q1. C5 is adjusted for optimum input matching to first stage amplifier Q1. The output at the collector of Q1 is coupled through C8 and L5 to the base of Q2. C11 adjusts the low-frequency portion (95 to 120 MHz) of the amplifier response. The signal at the Q2 collector is then coupled through C14 and L7 to the base of Q3. The response of the second amplifier stage is tuned to the high-frequency portion (120 to 145 MHz) of the amplifier response by C14 and C17. The wideband response (95 to 145 MHz) of the third amplifier stage Q3 is adjusted by L8. R9 adjusts the bias of all transistors while R11 compensates for any temperature vari-

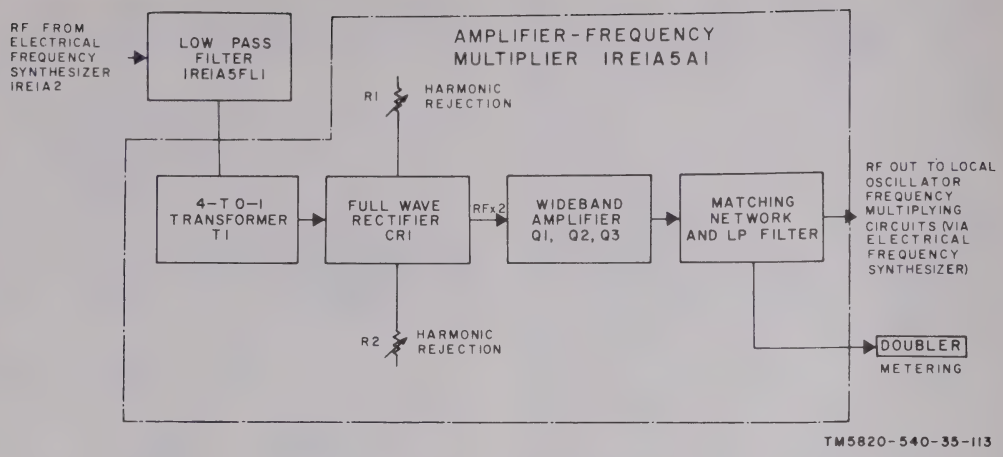


Figure 2-53. Amplifier frequency multiplier 1RE1A5, block diagram.

ation. The output of the third amplifier stage is fed into a bandpass filter circuit C22, L10, C23, C24, L11, L12, C26 which attenuates all unwanted harmonics. C23 and C24 adjust the response of the bandpass filter. L13 across the rf output prevents any output impedance variations from affecting the filter response. The filtered output at twice the input frequency is then coupled through C28 and E4 to P1–A2, the rf output connection, for distribution to the frequency multiplying circuits in the receiver rf head.
The DOUBLER, metering signal, derived directly from the rf output, is rectified by CR2 and the resulting dc signal is fed through R12 and FL3 to P1–10.

2–48. Power Supply 1RE1PS1
(fig. 2–54)

a. General. Power supply 1RE1PS1 converts the 115v ac input voltage to the dc voltages required for the operation of the receiver and the order wire unit. It provides regulated outputs of +12v and –12v dc for use by all transistor circuits and 26v dc unregulated for the operation of relays, indicator lamps and alarm circuits.

(1) The 115v ac from the AC connector at the rear of the receiver is applied through the AC POWER circuit breaker to the primary of input transformer T1. The two outputs of the transformer are individually rectified and filtered; one is used as the 26v dc unregulated supply, the other becomes the 24v dc regulated supply from which two 12v dc supplies are derived. Part of the second output voltage, taken from transformer T1, is fed into a preregulator circuit, which provides a constant current to the 24v dc regulator circuit.

(2) In the regulator circuit, a sample of the 24v dc regulated output is compared with a reference Zener diode voltage in a dc amplifier circuit. Any variation in the 24v dc output will produce an error voltage at the output of the amplifier Q1–Q2. This error voltage is then amplified and fed back to control the impedance of transistors Q1 and Q2 in series with the 24v output line. The change in impedance changes the output voltage in the proper direction to restore it to the preset nominal value. This nominal value is adjusted by the 24V VOLTAGE ADJUST control. The amplifier voltage regulator circuits are provided with a short circuit protection device. Zener diode CR4 in series with the 24v output voltage limits the current through Q2 of the series regulator in the event of short circuit, the 24v supply circuit being restored to normal when the short circuit condition is removed.

(3) The pre-regulator voltage increases the overall efficiency of series regulator Q1–Q2. This voltage is held constant above the regulated output voltage by Zener diode CR3 and is applied in parallel with the feedback control voltage to the base of Q2. The ripple on the output line is cancelled by a ripple feedback circuit adjusted by a HUM NEUTRALIZE control.

(4) The +12v dc and –12v dc supplies are derived from a pair of complementary shunt regulators, Q3 and Q4, which establish a zero reference (ground) potential exactly midway between the positive and negative sides of the 24v dc supply. Q3 and Q4 also provide return paths for unbalanced current between the two 12v dc supplies. The reference point is set by the

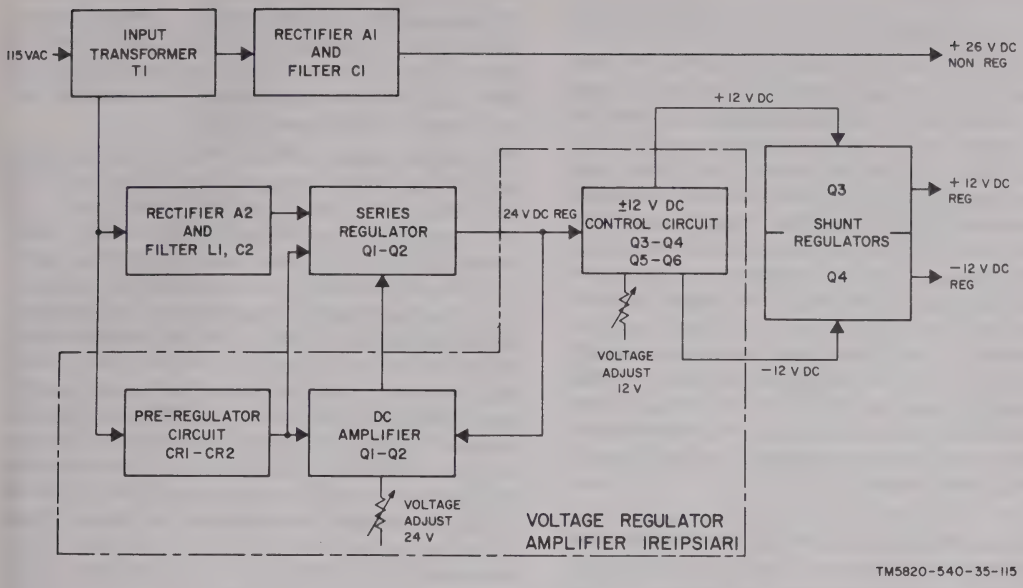


Figure 2-54. Power supply 1RE1PS1, block diagram.

12V VOLTAGE ADJUST control.

(5) The metering voltages are taken from the +12 v dc and –12v dc outputs, referenced to Zener diode voltages, and adjusted by individual meter calibration potentiometers in their respective voltage divider circuits.

b. Detailed Circuit Analysis (fig. 6–28).

(1) *26v dc unregulated supply.* The 115v ac source voltage is applied through P2–6 and P2–7 to the primary winding 1–2 of input transformer T1. The output at terminals 3 and 4 is rectified in A1 and the resulting 26v dc is connected to P2–4 and P2–5 for distribution. C1 and CR1, connected across the 26v dc line, provide filtering and overvoltage protection.

(2) *24v dc regulation.* The output at terminals 5 and 6 of T1 is fed to rectifier A2 and to the pre-regulator circuits in voltage regulator amplifier 1RE1PS1AR1. The 24v dc output of A2 is filtered by L1 and C2, is then fed to the collectors of Q1 and Q2, the series regulator circuit. Zener diode CR2 provides over-voltage protection of the 24v dc line. Series regulator transistors Q1 and Q2 (mounted on the heat sink) are connected in a high-gain dc amplifier arrangement, the emitter of Q1 being the regulated output line. The reference voltage for the 24v dc series regulator is developed from the 24v line through Zener diodes R9, CR5, and CR6 in voltage regulator amplifier 1RE1PS1AR1. The reference potential of 12v across CR5 and CR6 at the base of transistor Q2, is reflected in the Q1 emitter circuit by emitter-follower action to provide base-emitter temperature compensation for Q1. The voltage at the base of Q1 is derived from voltage divider R6, R7 and R8, connected across the 24v output line. 24V VOLTAGE ADJUST potentiometer R7 sets the series regulator output voltage to nominal. The peak potential taken across terminals 1 and 6 of transformer T1 is fed through J2 pins P and S to full-wave rectifier CR1 and CR2 in voltage regulator amplifier 1RE1PS1AR1, to be used as a preregulator voltage. C4 filters the pre-regulator voltage. The output of CR1 and CR2, clamped 6v above the regulated 24v by CR3, is fed through R1 and R2 to the collector of Q1, and through P1–U to the base of Q2 of the series regulator circuit. The constant current source to the base of Q2 effectively provides a second feedback control voltage in parallel with the control voltage derived from potentiometer R7 and applied to the base of Q1. Any change in the 24v dc output voltage will cause a change in the Q1 emitter-collector; this change in current will be added or subtracted from the current to the base of Q2 of the series regulator. This will change the Q2 emitter-collector impedance and simultaneously change the voltage drop across Q1 in the correct direction to

compensate for the change in the output voltage, thus restoring the 24v dc output voltage to nominal. R28 and CR4 form an over-current protection device for series regulator circuit Q1 and Q2. The voltage drop across R28, Q1 and Q2 will approach 4.3v as the current approaches 2.2 amperes. As it reaches 4.3v, CR4 fires and causes the voltage at Q2 base to drop, by-passing the nominal feedback control voltage and limiting the current through Q1 to 2.2 amperes. This current-limiting function effectively protects the power supply against any direct short circuit, restoring the voltage to normal as soon as the short circuit has been removed. Ripple voltage of the pre-regulator supply is fed through R3 and R5 (HUM NEUTRALIZE potentiometer) to the base of control transistor Q1 in the correct polarity to neutralize the ripple in the regulated output.

(3) *+12v and –12v dc regulated supply.* The center zero voltage reference point is maintained exactly midway between +12v dc and –12v dc by the action of shunt regulator transistors Q3 and Q4, mounted on the heat sink. Q3 and Q4 act as load resistances across the +12v dc and –12v dc supplies and as such equalize the current around the zero reference value. The circuits that control the +12v and –12v dc shunt regulation consist of transistors Q3 through Q6 of voltage regulator amplifier 1RE1PS1AR1. Zener diode CR7 provides the reference voltage used in the shunt regulator control circuit. CR7 clamps the Q4 base voltage 6 volts below the dc common (ground) line. The Q3 emitter is connected to the emitter of Q4, effectively clamping it to the reference voltage. The voltage at the base of Q3 (voltage regulator amplifier) is taken through divider R10, R11, and R12 across the 24v dc regulated supply, and adjusted by R11 to set up the zero reference point at Q3 collector. If the output currents on the +12v and –12v dc lines become unbalanced, this zero reference level will tend to drift toward one of the output voltages; this will cause a change in the Q4 emitter current (voltage regulator amplifier 1RE1PS1AR1AR1). Since the Q4 base is clamped to the same voltage as the Q3 collector by the action of Zener diode CR7, its collector voltage will change and will permit either Q5 or Q6 to draw base current. Since Q5 is a PNP transistor and Q6 is an NPN transistor, their reactions to a change in base voltage are complementary. As a result, either shunt regulator transistor Q3 or Q4 on the heat sink will draw emitter-collector current to balance the two current load. Capacitors C2 and C5 prevent the regulator circuits from oscillating. Thus if the +12v current exceeds the –12v current, Q4 will pass the inbalance current, and if the –12v current exceeds the +12v current, Q3 will pass the imbalance current.

(4) *Metering circuits.* The metering voltages of the +12v dc supply are taken from voltage divider R21, R22, and R23, across the +12v dc supply, and fed through R29 to the +12V meter connection on the front panel. The negative side of the meter (meter common) is returned to a 6-volt reference voltage across CR8, thus establishing an expanded scale for meter reading. A 10 percent of full scale deflection on the meter scale represents a 0.5v change in the output voltage. R22 is the 12v dc meter calibration potentiometer. A similar meter circuit is provided for the –12v dc supply, which is derived from voltage divider R18, R19, and R20. The –12v dc metering voltage is referenced to Zener diode CR9. R19 is the –12v dc meter calibration potentiometer.

2–49. Receiver Metering Circuits

a. General. The receiver metering circuits include a 100-microampere meter which is connected into the various metering circuits by a 12-position rotary selector switch. The receiver metering circuits give an indication of power and voltage levels throughout the receiver fixed and rf heads. The meter has a 0-to-100 scale with a green band in the center. For any selector switch position marked with a green dot, a normal meter reading should fall within the green band. Each metering circuit has its own meter-matching circuit and a calibration resistor so that this single meter can serve to indicate various power and voltage ranges. The following chart lists the metering circuits of the receiver and their nominal indications:

Switch position	Nominal value	Scale reading (percentage of full-scale)
REFL PWR	Zero power	10
XMTR DUPL	20 watts (antenna)	65
OSC	25 milliwatts	50
DOUBLER	30 milliwatts	50
MULT	+6 dbm	40 to 50
RCVR SIG	–74 dbm (antenna)	50
12 CH PCM	2.0v pp/91 ohms	50
24 CH PCM	265 milliwatts rms 51 ohms	50
FDM	–4 dbm/91 ohms	50

Switch position	Nominal value	Scale reading (percentage of full-scale)
OW	–10 dbm/600 ohms	50
+12V	+12v dc	50
–12V	–12v dc	50

b. Metering Circuits Analysis (fig. 2–55). For point-to-point tracing of metering circuits, refer to figure 6–29.

(1) *REFL PWR metering (position 1).* The REFL PWR metering gives an indication of reverse power at the antenna connector. The rf signal from the reverse-power coupling probe is detected, to produce a dc signal proportional to the amount of reflected power sensed through power monitor 2A1A5. A thermistor connected across the detector circuit provides a constant output independent of temperature. The resulting dc signal is fed through distribution box 1A2A1 into monitor panel 1RE1A1 and meter selector switch S1–A (meter positive). The negative side of the meter is returned through S1–B and the distribution box to the meter common point in the received rf head. Normal indication is almost zero power (less than 10 percent of full scale).

(2) *XMTR DUPL metering (position 2).* The XMTR DUPL metering circuit gives an indication of the forward (output) power at the ANT. connector. A thermistor-controlled detector circuit in series with the forward power coupling probe produces a dc signal proportional to forward power going through power monitor 2A1A5 (para 2–30). The thermistor, connected across the detector circuit, provides the same output independent of temperature. The dc signal is fed through distribution box 1A2A1 to monitor panel 1RE1A1 and meter selector switch S1–A (meter positive). The meter common is returned to ground at the receiver rf head through the distribution box. A nominal 20 watts at the antenna will produce a 65 percent meter indication.

(3) *OSC metering (position 3).* The OSC meter position gives an indication of the electrical frequency synthesizer 1RE1A2 output signal as it is fed into amplifier-frequency multiplier 1RE1A5. A portion of the rf signal at the output of modulator-oscillator 1RE1A2A2 (para 2–4) is rectified by CR4 to produce a dc metering signal proportional to the rf signal. The dc signal is then fed through R20 and FL5, through interconnecting box 1RE1A2A1 in electrical frequency synthesizer 1RE1A2, and monitor panel 1RE1A1 to meter selector switch S1–A (meter positive). The meter return is grounded at interconnecting box 1RE1A2A1 (fig. 6–11). A 50 percent of full scale indication on the meter is equivalent to approximately 25 milliwatts rf output. 40 to 60 percent of full scale represents a synthesizer output ranging approximately from 15 to 40 milliwatts.

(4) *DOUBLER metering (position 4).* The DOUBLER metering signal is derived from the rf output of amplifier-frequency multiplier 1RE1A5 (para 2–47) which is used to drive frequency multiplier 2A1A2A1 (para 2–35). A portion of the output signal is rectified in CR2, then filtered by R12 and C27 to produce a dc voltage suitable for metering. The dc signal is then fed through interconnecting box 1RE1A2A1 to monitor panel 1RE1A1 and meter selector switch S1–A (meter positive). The metering return line is fed through interconnecting box 1RE1A2A1 to frequency multiplier 1RE1A5. The meter circuit has been calibrated to give a 50 percent of full scale indication for a nominal 30 milliwatt (+13 dbm) output signal. 40 to 60 percent of full scale meter indications represent approximately 20 to 35 milliwatts output signal.

(5) *MULT metering (position 5).* The MULT metering signal gives an indication of the local oscillator signal level and is taken at the input to frequency mixer stage 2A1A2A2. A portion of the local oscillator input to the frequency mixer stage is rectified by CR1 and filtered to produce a dc signal suitable for metering. The dc voltage is fed through distribution box 1A2A1 to monitor panel 1RE1A1 and meter selector switch S1–A (meter positive). The meter common is returned to the receiver rf head through distribution box 1A2A1. A local oscillator signal of +6 dbm will provide a 40 to 50 percent of full scale indication.

(6) *RCVR SIG metering (position 6).* The RCVR SIG metering gives an indication of the level of the incoming received signal at the antenna connector. The metering signal is derived from the agc voltage generated in intermediate frequency amplifier 1RE1AR2, which adjusts the gain of the receiver IF amplification system. The agc voltage from intermediate frequency amplifier 1RE1AR2 is routed through electrical frequency limiter-discriminator 1RE1A4 into video amplifier 1RE1AR1. The agc voltage is then fed through inductor L2 to monitor panel 1RE1A1 and through diode CR1 of circuit card assembly 1RE1A1A3 to switch S1–B (position 6) and the negative side of the meter. RCVR SIG ADJ control potentiometer R1 of circuit card assembly 1RE1A1A3 is connected across the meter at this position and calibrates the scale to

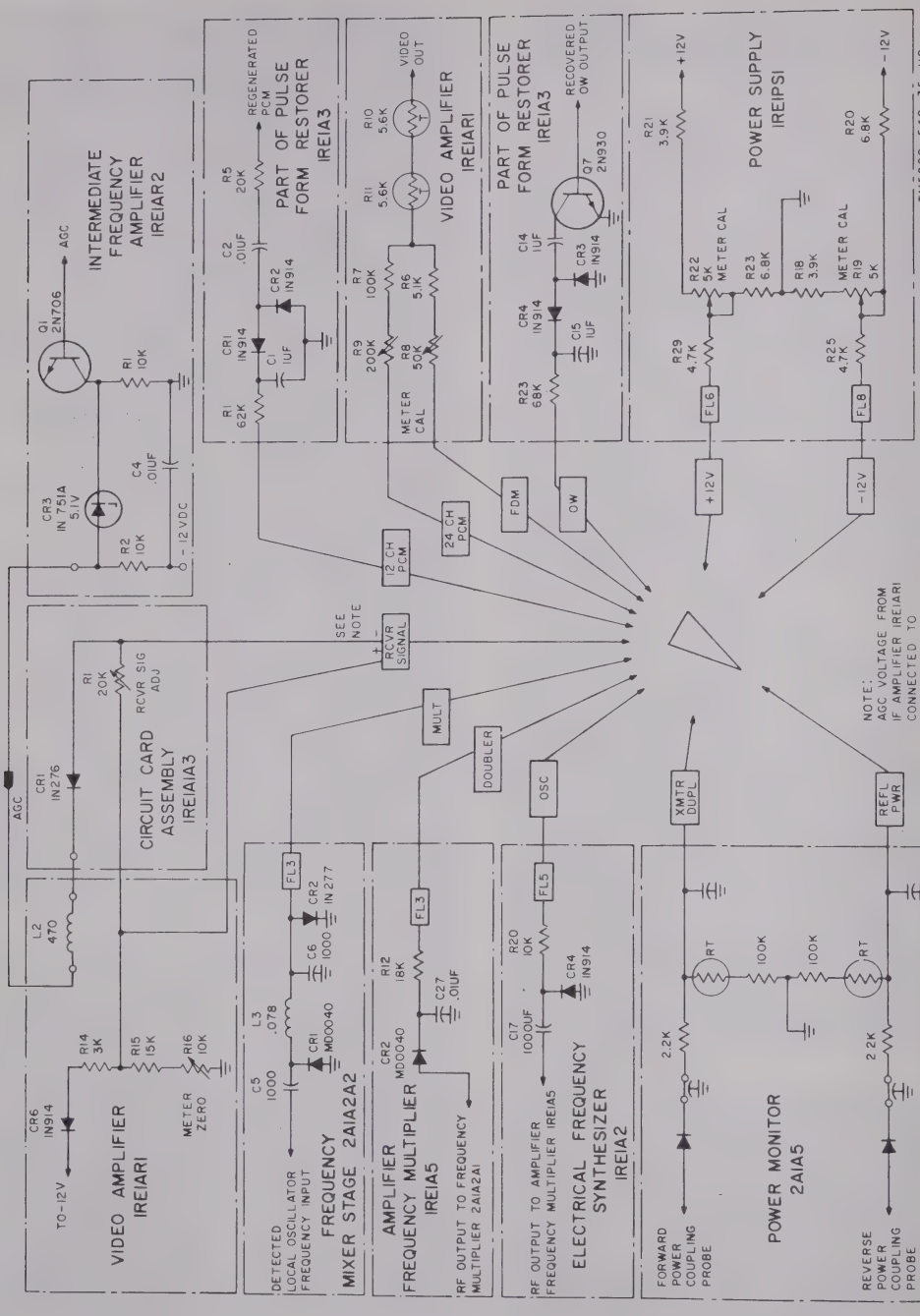


Figure 2-55. Receiver metering circuits, simplified schematic diagram.

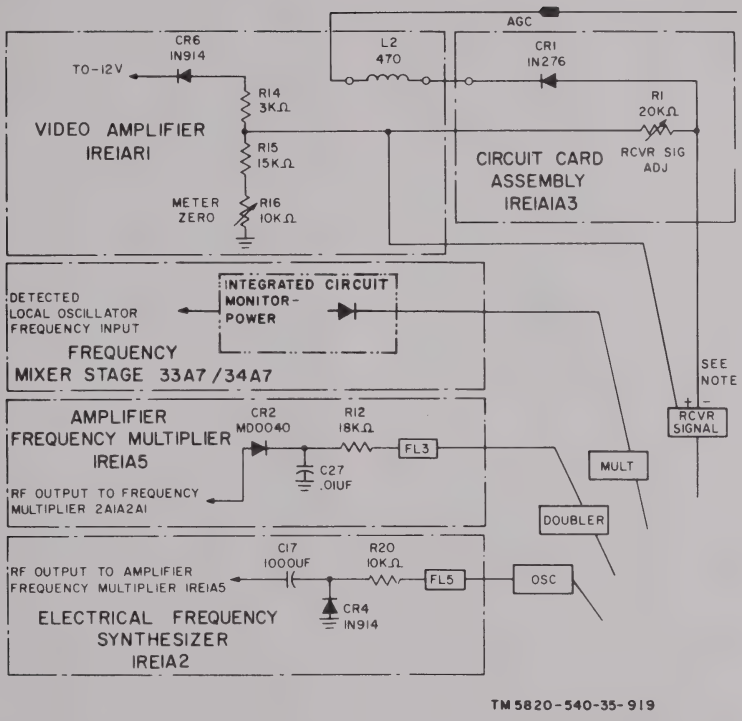


Figure 2.55.1 Local oscillator metering circuits, simplified schematic diagram (bands II and III).

indicate 50 percent of full scale deflection for a –74 dbm received signal at the antenna port. The positive side of the meter is returned through S1–A to video amplifier 1RE1AR1 to a point on voltage divider CR6, R14, R15, and R16 connected between –12v dc and ground. R16 is the meter zero adjustment when no signal is present at the antenna connector.

(7) *12 CH PCM metering (position 7).* The 12 CH PCM metering provides an indication of the regenerated pcm level at the output of pulse form restorer 1RE1A3. Upright regenerated pcm pulses from the gated multivibrator (para 2–45) are fed through R5 and C2 to metering detector CR1 and CR2. The rectified dc signal, suitable for level metering, is fed through R1 and P1–9 to monitor panel 1RE1A1 and switch S1–A (meter position). The meter common is returned to ground in pulse form restorer 1RE1A3. The meter is calibrated to indicate 50 percent of full scale for a 2.0-volt peak-to-peak (in 91 ohms) regenerated pcm output signal.

(8) *24 CH PCM and FDM metering (positions 8 and 9 respectively).* 24 CH PCM and FDM metering give an indication of the video levels at the receiver output; these levels are used mainly for system line-up. The metering voltages are derived from the video output of video amplifier 1RE1AR1 (para 2–44). A portion of the video output is amplified in a two-stage amplifier, then rectified to produce dc signals suitable for metering. The metering circuit is stabilized for varying temperatures by two thermistors in series. The metering signal is then split into two paths; the 24 CH PCM metering signal is taken through R7 and Rp to monitor panel 1RE1A1 switch S1–A (meter positive). R9 adjusts the level of the 24 CH PCM metering voltage to indicate 50 percent of full scale when the video output level at the VIDEO OUT connector is 265 millivolts rms in 51 ohms (equivalent to a ±300-kHz peak deviation). The fdm metering signal is taken through R6 and R8 to monitor panel 1RE1A1 and switch S1–A (meter positive, position 9). R8 adjusts the level of the fdm metering voltage to indicate 50 percent of full scale when the video output level at the fdm connector is –4 dbm in 91 ohms (equivalent to ±75 kHz peak deviation). The meter common of both 24 CH PCM and FDM is returned to the –12-volt dc line in video amplifier 1RE1AR1.

(9) *OW metering (position 10).* The OW metering circuit provides an indication of the recovered order wire signal level at the output of pulse form restorer 1RE1A3. A portion of the recovered order wire signal is first amplified, then rectified in metering detector circuit CR3 and CR4. The resulting dc signal is then connected through R23 to monitor panel 1RE1A1 and switch S1–A (meter positive). The meter common is returned to ground in pulse form restorer 1RE1A3. A 50 percent of full scale indication is equivalent to an order wire signal level of –10 dbm in 600 ohms.

(10) *+12V and –12V metering (positions 11 and 12 respectively).* The +12V and –12V metering voltages are derived from the corresponding outputs of voltage regulator amplifier 1RE1PS1AR1 of power supply 1RE1PS1 (para 2–48). Metering voltage for the +12v dc regulated supply is derived from voltage divider R21, R22 and R23, across the +12v dc supply, and fed through R29 to monitor panel 1RE1A1 and switch S1–A (meter positive, position 11). The meter common is returned to voltage regulator amplifier 1RE1PS1AR1 and connected to the cathode of diode CR8 which raises its potential to 6 volts, thus establishing an expanded scale for meter reading. Control R22 adjusts the meter reading to indicate 50 percent of full scale for 12v dc. A 10 percent variation on the meter scale represents a 200-millivolt change in output voltage. Metering voltage for the –12v dc regulated supply is derived from R20, R19 and R18 across the –12v dc circuit and fed through R25 to monitor panel 1RE1A1 and switch S1–A (meter positive, position 12). The negative side of the meter is returned to voltage regulator amplifier 1RE1PS1AR1 and connected to the cathode of diode CR9 to obtain an expanded meter scale. Potentiometer R19 adjusts the meter to indicate 50 percent of full scale for –12v dc. A 10 percent variation on the meter scale represents 200 millivolts change in output voltage.

2–50. Receiver Alarm Circuits

a. General. The receiver alarm circuits are part of monitor panel 1RE1A1 (front panel of receiver fixed head) and work in conjunction with the alarm circuits in the receiver fixed head, electrical frequency synthesizer 1RE1A2, and video amplifier 1RE1AR1, and electronic switch 2A4 in the receiver rf head. Monitor panel 1RE1A1 includes alarm control 1RE1A1A2, four indicator lights (AC POWER, SYNC, LOW SIGNAL, and HIGH SIGNAL), one buzzer, and three manually-controlled switches (AC POWER ON–OFF, BUZZER OFF and BUZZER OFF–ALARMS NORMAL). The buzzer sounds when a change of state occurs in the associated alarm circuits. A fault will cause the buzzer to sound.

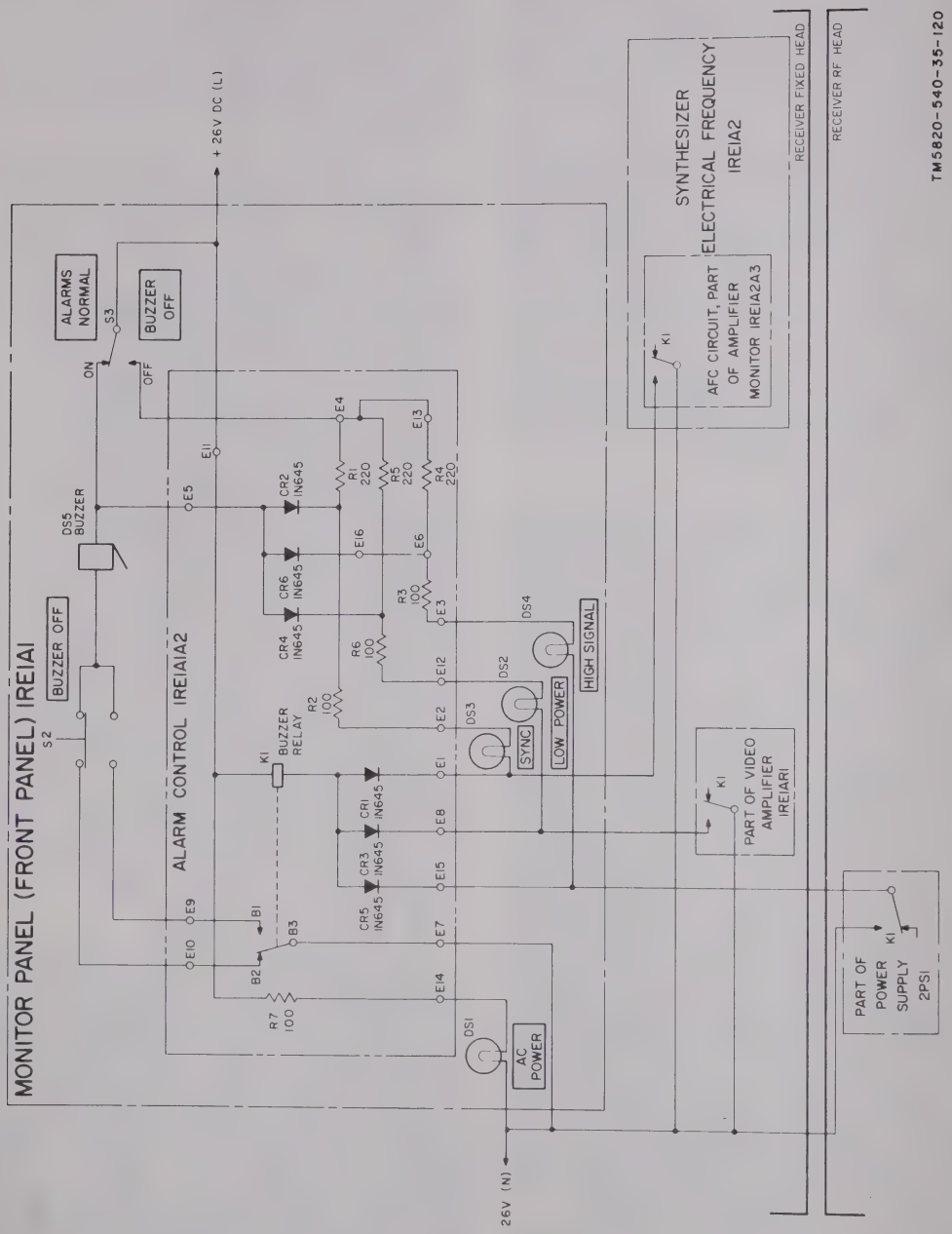


Figure 2-56. Receiver alarm circuits, simplified schematic diagram.

Pushing the BUZZER OFF switch silences the buzzer. Once all fault indications are corrected, the buzzer will sound again until the BUZZER OFF switch is operated again. A built-in switch (BUZZER OFF–ALARMS NORMAL) enables the buzzer to be muted and the lamps dimmed during testing, alignment, and correction of fault conditions.

b. Indicator and Alarm Circuits Description (fig. 2–56). For point-to-point tracing of indicator and alarm circuits, refer to figure 6–29.

(1) *Ac input circuit.* When ac power is switched on, +26 volts dc from power supply 1RE1PS1 is fed through P2–4 and J1–4 into monitor panel 1RE1A1, and through E11 of alarm control 1RE1A1A2 to one side of buzzer control relay K1 and to AC POWER indicator lamp DS1, through R7 and E14. The 26v dc is returned through J1–5 and P2–5 to power supply 1RE1PS1. +26 volts dc is also applied through the BUZZER OFF–ALARMS NORMAL switch (in the ALARMS NORMAL position) to one side of the buzzer. The dc path through the buzzer is closed through contacts of buzzer control relay K1.

(2) *SYNC (afc) alarm.* The SYNC alarm circuit operates in conjunction with SYNC alarm relay K1 in amplifier-monitor 1RE1A2A3 (para 2–14) of electrical frequency synthesizer 1RE1A2. Normally the SYNC alarm relay is held operated by the afc SYNC alarm detector circuit and by the clock pulse D integrator. The SYNC alarm relay drops out either when afc voltage is outside limits or when clock pulse D is absent. The operating range of the SYNC alarm relay (2.5 volts to 10 volts on the afc line) is established by Zener diode CR3 and potentiometer R3 and corresponds to frequency control limits in the vco. When the afc voltage is outside these limits, the afc of the vco has been lost, and the SYNC alarm relay drops out. Normally clock pulse D, fed into the integrator, holds control transistor Q4 operated and in turn relay control transistor Q5 is cut-off and the SYNC alarm operates. In the absence of clock pulse D the relay drops out. When the relay is de-energized the +26-volt dc path through SYNC indicator lamp DS3, the buzzer control relay, and control diode CR1 in alarm control 1RE1A1A2 is closed. The circuit passes through monitor panel 1RE1A1, and interconnecting box 1RE1A2A1 of electrical frequency synthesizer 1RE1A2, to amplifier-monitor 1RE1A2A3. The SYNC lamp illuminates and the buzzer sounds; the BUZZER OFF switch silences the buzzer while the alarm condition is being corrected. When normal operating conditions are restored, the SYNC alarm relay in the synthesizer is energized, and opens the +26-volt dc path. The SYNC indicator lamp is out, the buzzer relay drops out, and the buzzer sounds. Pushing the BUZZER OFF switch restores buzzer circuits to normal.

(3) *LOW SIGNAL alarm.* The LOW SIGNAL alarm circuit operates in conjunction with the low signal alarm circuits in video amplifier 1RE1AR1 (para 2–44) and provides an alarm indication and squelch of the pcm signal when the noise content determines that the received signal is below the minimum operating level. A portion of the amplified video signal (VIDEO OUT) is fed through a filter which extracts the high-frequency noise components (520 kHz to 2 MHz). The extracted noise signal is first amplified, then rectified in alarm control 1RE1AR1A3. The resulting dc signal is used to control Schmitt trigger circuit Q4 and Q5, with a turn on/turn off operation. Normally the Q5 base is held at about –0.6v by CR5 and R10. When the voltage at the rectifier output raises the voltage at the Q5 base to about +0.7v, corresponding to a received signal level of –99 dbm at the antenna connector, Q5 starts to conduct. This causes the base of Q4, a PNP transistor, to go negative and drive it into conduction. Q4 controls the current through low signal alarm relay K1, causing it to operate. K1, energized, closes the –26v dc path through LOW SIGNAL alarm indicator lamp DS2 and buzzer control relay K1 through control diode CR3. At the same time, low-signal alarm relay K1 in the video amplifier breaks the regenerated pcm output path terminating the pcm output in R17 (51 ohms). The operation of the buzzer in the event of a LOW SIGNAL alarm condition is as described in (2) above for the SYNC alarm. When the received signal level increases to approximately –96 dbm, Q5 and Q4 are cut-off and the low signal alarm relay is de-energized. The 3-db backlash prevents jittering when operating with near-limit signals. The 26v dc to the LOW SIGNAL lamp is off but the buzzer sounds. Pushing the BUZZER OFF button restores the buzzer circuits to normal.

(4) *HIGH SIGNAL alarm.* The HIGH SIGNAL alarm circuit operates in conjunction with HIGH SIGNAL indicator lamp DS4 on the front panel of the receiver fixed head and with the receiver protection circuits (para 2–31) in the receiver rf head. A detector diode connected in the receive arm stripline of electronic switch 2A4

senses the received rf level. When the received rf level reaches –10 dbm the dc output of the diode is sufficient to drive the high gain microcircuit differential dc amplifier whose output becomes positive under high signal condition (–10 dbm). The differential dc amplifier output is fed to an emitter-follower stage with two outputs. One of the outputs, the alarm drive, is fed into power supply 2PS1 to the base of Q2. Under high signal conditions, the alarm drive signal voltage will turn on Q2. The drop in voltage at the Q2 collector turns on Q1, a PNP relay drive transistor, which in turn will cause high-signal alarm relay K1 in power supply 2PS1 to energize. K1, when energized, closes the 26v dc path through HIGH SIGNAL indicator lamp DS4 (alarm control 1RE1A1A2) and buzzer control relay K1. The HIGH SIGNAL lamp illuminates and the buzzer sounds. At the same time, the rf receive path is opened and the high received signal is dissipated in the dummy load. When the received signal drops below –10 dbm the rf receive path is reestablished and alarm indications are received.

(5) *BUZZER OFF–ALARMS NORMAL switch.* In the BUZZER OFF position, this switch removes the +26-volt dc supply from the buzzer circuit and connects additional 220 ohm dimming resistors, R1, R5, and R4, in series with the SYNC, LOW SIGNAL, and HIGH SIGNAL indicator lamps respectively.

Section V. RECEIVER-TRANSMITTER ORDER WIRE RT–773/GRC–103(V)

2–51. Order Wire Unit

a. General. The order wire unit provides a handset facility, with ringing on a party-line basis, to all communication points in the radio system. At a repeater station, the unit provides for talking and signalling simultaneously in both directions of transmission, and provides a through circuit for the party-line communication. The order wire unit operates as an active 4-wire, 3-way hybrid which permits one order wire unit to operate with two radio sets in a repeater configuration. For transmission, the order wire send signals are connected to amplifier-monitor 5TR1A5 of each radio set, where they are added to the baseband signal. The order wire receive signals are connected from pulse form restorer 1RE1A3 of each radio set to the order wire unit. The speech and ring-out signals are fed to both transmitters; both receive path signals are fed into the handset receiver, as well as to the ringing receiver, to activate the buzzer and the CALL lamp. When the system is carrying pcm video, the order wire unit provides a through-path for order wire signals as well as the local send and receive functions. The order wire through-path, however, is opened during fdm operation, to prevent parallel-path signal cancellation. The order wire circuits are contained on two printed circuit boards interconnected through the front and rear panel wiring. Amplifier assembly 9A4 interconnects the order wire circuits of two radio sets and a handset, by means of an active 4-wire 3-way hybrid; in addition, the order wire amplifier introduces a sidetone into the handset receiver. Telephone signal converter 9A3 generates a 1,600-Hz signalling tone for calling over the system and also detects the 1,600 Hz incoming call signal. The telephone signal converter circuits operate in conjunction with the RING switch, the CALL indicator light, and the buzzer. The 12v dc required for the operation of the order wire circuits, and the 26v dc required for the buzzer and front panel lights, are obtained from either receiver (A or B). Two power control relays choose the receiver which will supply the required voltages. In repeater operation these voltages are normally obtained from receiver A.

NOTE

In a repeater configuration, radio set A is connected to the TO RADIO connector, while radio set B is connected to the PATCH THRU connector.

b. Block Diagram Analysis (fig. 2–57).

(1) *Through path.* The order wire signal from receiver A (speech and/or signalling) in the range of 200 Hz to 3 kHz at a level of –10 dbm/600 ohms is fed into amplifier-splitter Q1. One of the two outputs of Q1 is fed through PCM/FDM switch S1 to amplifier Q2. The output of Q2 is then filtered and fed to transmitter B. Similarly, the incoming signals from receiver B are fed into amplifier-splitter Q5. One of the two outputs of Q5 is fed through PCM/FDM switch S1 to amplifier Q6 and then to transmitter A through a 3-kHz low pass filter. Crosstalk from receiver A to transmitter A is at least 40 db below signal level.

(2) *Handset receive-transmit paths.* The second output of amplifier-splitter Q1 (receiver A) is fed to the input circuit of transformer T1 whose secondary winding feeds the handset receiver. Similarly the second output of amplifier-

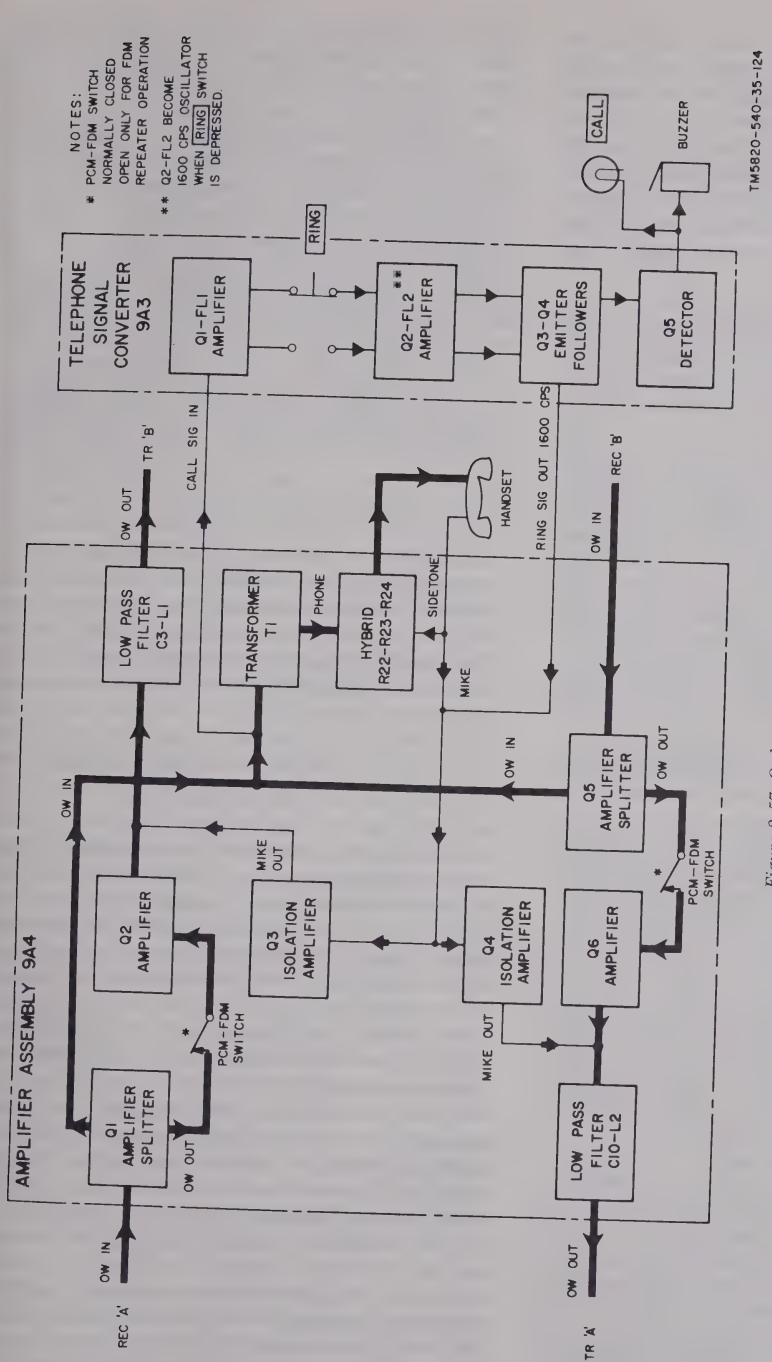


Figure 2-57. Order wire unit, block diagram.

splitter Q5 (receiver B) is fed to the input circuit of T1. Speech signals from the handset (PRESS-TO-TALK switch operated) at a level of –18 dbm are connected simultaneously to isolation amplifiers Q3 and Q4. The output of Q3 is then fed through the low pass filter to transmitter B, while the output of Q4 is fed through the outputs of splitter-amplifiers Q1 and Q5 and Q4 also provide limiting of speech signals if required.

(3) *Sidetone.* Speech signals from the microphone are coupled into a 6-db resistive hybrid with the earphone connected as one arm of the bridge. This results in the speech signal from the microphone appearing at the earphone at a level of –24 dbm.

(4) *Signalling receive path.* The incoming signals from receiver A or receiver B containing the 1,600 -Hz signalling frequency are taken off the outputs of splitter-amplifier Q1 and Q5 and fed to telephone signal converter 9A3. The signal is first amplified, in a highly selective filter, Q1 and FL1 then fed through normally closed contacts in the RING switch to a second amplifier stage with an identical selective filter, Q2 and FL2. The output of the filter is coupled through a pair of cascaded emitter-followers Q3 and Q4, a gain control, and, through a second pair of normally-closed contacts on the RING switch, to detector amplifier Q5 to operate the ring relay. The relay operates the buzzer and CALL lamp.

(5) *Signalling send path.* When signalling to other sites in the system is required the RING switch must be depressed. This action opens the connection between the output of Q1 and the input of Q2, and turns Q2 into an oscillator. The oscillator output is then connected through Q3 and Q4, emitter-followers through the RING switch, now closed, to the same amplifier input point (Q3, Q4) as speech signals from the handset microphone. Level at this point will be 330 millivolts. Signalling is then transmitted through Q3 and Q4 in both directions.

2–52. Amplifier Assembly 9A4

a. General. Amplifier assembly 9A4 consists of three two-stage amplifiers Q1–Q2, Q3–Q4, and Q5–Q6, each giving two mutually isolated outputs, and a bridge for the sidetone circuit. The order wire outputs from the two radio receivers are fed one each to an amplifier pair, Q1–Q2 and Q5–Q6. The handset output is fed to amplifier Q3–Q4, which also provides amplitude limiting.

(1) The two mutually isolated outputs of Q3 and Q4 transistors are combined with the secondary outputs of the other two amplifiers (Q2 and Q6 collectors) and fed to radio transmitters A and B inputs respectively. R7 and R18 are common gain controls for the Q2–Q3 and Q4–Q6 combined outputs respectively.

(2) The collector outputs of transistors Q1 and Q5 are combined in a common collector load and then fed through transformer T1 and a 6-db hybrid bridge to the handset receiver (PHONE). The sidetone is injected into the handset receiver through the same hybrid bridge. **Decoupling capacitors C15, C17, and C16, C18 suppress parasitic oscillations and reduce cross-talk distortion.**

b. Detailed Circuit Analysis (fig. 6–30).

(1) *Through path—PCM mode.* Incoming signals (speech and/or signalling) from receiver A (J1–E) are applied at P4–K, and are coupled through C1 to the base of transistor Q1. The Q1 emitter output is fed through R5, C2, and S1–A PCM/FDM switch (in the PCM position) to the emitter of transistor Q2. The Q2 collector output is then fed through low pass filter C3–L1 and P4–L to transmitter B (J2–G). Similarly, incoming signals from receiver B (J2–E) are applied to P4–F and are coupled through C13 to the base of transistor Q5. The Q5 emitter output is fed through R28, C14, and switch S1–B to the emitter of transistor Q6. The Q6 collector output is then fed through low pass filter C10–L2, and P4–H to transmitter A (J1–G).

(2) *Handset receive-transmit path.* The handset receiver gets its signals from the collector output of Q1 (receiver A) and Q5 (receiver B). Q1 and Q5 collectors have a common collector load R4. The combined outputs are then fed through transformer T1 through the active 4-wire 3-way hybrid, R22, R23, and R24, to the handset receiver (PHONE) through P4–J. The local microphone circuit (MIKE) applied to P4–C (PRESS-TO-TALK switch depressed) is coupled through C8 simultaneously to the bases of amplifiers Q3 and Q4. Q3 and Q4 each amplify the local microphone or ringing signal, and also function as peak limiters to prevent overmodulation on high level speech peaks. R10 and R20 are the peak limiting resistors. The Q3 collector output is then combined with the Q2 collector output and fed through C3 and L1 to transmitter B. Similarly, the Q4 collector output is combined with the Q6 collector output and fed through C10 and L2 to transmitter A. Part of the incoming microphone signal (sidetone) is coupled through C6 to one side of the hybrid bridge and fed through R23 to the handset receiver.

(3) *Signalling path.* Part of the combined

outputs of Q2 and Q6 are fed through C9, R17, and P4–B to telephone signal converter 9A3 (para 2–53) where the 1,600-Hz CALL signal is extracted. The 1,600-Hz RING signal from telephone signal converter 9A3 is fed through P4–E into amplifier assembly 9A4. The 'RING' signal is then fed through R13 and C7 to the Q3–Q4 amplifier pair for transmission in both directions.

(4) *Through path-FDM mode.* The patch-thru facilities of amplifier assembly 9A4 are disabled when switch S1 is in its FDM position. This is done in order not to interfere with the patch-thru facilities of the fdm repeater equipment. However, the handset receive and transmit facilities, as well as signalling facilities (CALL and RING) in both directions of transmission are not affected.

2–53. Telephone Signal Converter 9A3

a. General. This unit, in conjunction with amplifier assembly 9A4 and monitor panel 9A2, provides signalling facilities on the order wire channel. Telephone signal converter 9A3 consists of a three-stage amplifier and a detector circuit driving a relay. The second stage functions as a 1,600-Hz generator when the RING switch is depressed.

b. Detailed Circuit Analysis (fig. 6–30).

(1) *CALL signal in.* Part of the incoming signal (speech and signalling) from amplifier assembly 9A4 is applied through distribution panel 9A1 wiring to P1–L of telephone signal converter 9A3. The signal is then applied through SENSITIVITY control R1 and capacitor C1 to the base of transistor Q1. FL1 in the Q1 collector circuit is tuned to 1,600 Hz ±4 Hz, and capacitor C2 provides fine frequency tuning of the selective circuit. The output from FL1 is then connected through normally-closed contacts 4 and 5 of RING switch S1 in monitor panel 9A2, back into telephone signal converter 9A3 and coupled by capacitor C3 to the base of transistor Q2. Q2, and FL2 in its collector circuit, form another highly selective amplifier tuned to 1,600 Hz ±4 Hz. Capacitor C4 provides fine frequency tuning of FL2. The output of Q3 is coupled through C5 to the base of Q3. Q3 and Q4 are emitter followers connected in cascade. In the presence of 1,600-Hz signalling frequency extracted by Q1–FL1 and Q2–FL2, the output at the emitter of Q4 is fed through C6 and R13 GAIN potentiometer, through normally-closed contacts 8 and 1 of RING switch S1 in monitor panel 9A2, back into telephone signal converter 9A3, to the base of detector Q5. Q5 operates CALL relay K1 which in turn closes the 26v path through the BUZZER ON-OFF switch (in the ON position) in monitor panel 9A2, to the buzzer, and, through R1, to CALL lamp DS1. When the BUZZER ON-OFF switch is in its OFF position, the buzzer is bypassed, and the CALL lamp will glow at about half normal brightness due to series resistor R2.

(2) *RING signal out.* When the RING switch on monitor panel 9A2 is depressed, the output of FL2 in telephone signal converter 9A3 is connected through contacts 3 and 6 of the RING switch, and capacitor C3, to the base of transistor Q2, thus forming a Hartley-type oscillator which oscillates at 1,600 Hz ±4 Hz. The 1,600-Hz output is connected through C5 to emitter-followers Q3 and Q4. The output at the Q4 emitter is then conected through C6, GAIN control R13, and contacts 7 and 2 of the RING switch to P1–E of amplifier assembly 9A4. The RING signal out is then fed through R13, C7, and C8 to the bases of transistors Q3 and Q4. The two separate ringing signals are then transmitted along the transmit speech paths to the TO RADIO and PATCH THRU connectors.

2–54. Distribution Panel 9A1

(fig. 6–31)

a. Distribution panel 9A1 (rear panel) contains all interconnecting circuits of the order wire unit including the TO RADIO and PATCH THRU connectors, resistor assembly board 9A1A1, two power distribution relays K1 and K2, and the buzzer. Power is fed to the order wire unit from the receiver to provide listening watch facilities with the transmitter switched off. Two power distribution relays, K1 and K2, enable power to be supplied from either the TO RADIO or the PATCH THRU connector. When only one radio set is connected, as in a terminal, the 26v dc at the TO RADIO connector operates K1 and K2 to route the 12v dc to amplifier assembly 9A4 and to telephone signal converter 9A3, and the 26v dc to monitor panel 9A2. When both radio sets are connected, as in a repeater, the same power distribution takes place; the second power source at the PATCH THRU connector stops at the opened contacts of K1 and K2. If a failure should occur in the radio set supplying power to the TO RADIO connector, the two relays will de-energize and supply power from the second radio set at the PATCH THRU connector to operate the order wire unit.

b. Resistor assembly 9A1A1 contains two 620-ohm resistors that change the order wire transmit level from –4 dbm to –10 dbm when the order wire facility is extended to Multiplexer TD–754/G or TD–204/U in a pcm terminal, 24-channel radio-to-cable configuration. When used in this configuration, J1–K or J2–K is grounded in the multiplexer; otherwise J1–K and J2–K remain open.

2–55. Monitor Panel 9A2

(fig. 6–31)

Monitor panel 9A2 (front panel) contains CALL and POWER lamps DS1 and DS2, BUZZER ON-OFF switch S2, RING switch S1, and resistor assembly 9A2A1, which contains indicator lamp resistors R1 and R3 and CALL lamp dimming resistor R2.

Section VI. AMPLIFIER-FREQUENCY MULTIPLIER AM–4321/GRC–103(V)

2–56. Functional Block Diagram Analysis of Amplifier-Frequency Multiplier AM–4321/GRC–103(V)

(fig. 2–58)

The RF output of the transmitter fixed head in the frequency range of 95 to 145 MHz, at a level of 35 dbm, is fed into amplifier-frequency multiplier AM–4321/GRC–103(V) (band II transmitter RF head) where it is multiplied and amplified to produce the final transmitter frequency.

a. The transmitter RF head multiplication circuits provide the final multiplication required to produce the selected transmitter channel frequency. The multiplication is accomplished in frequency multiplier 37A1 which contains a frequency doubler and a variable multiplier which extracts the second or third harmonics of the doubled frequency. The multiplication factor of the variable frequency multiplier is selected by a switching circuit controlled by control line 13 from control-indicator 37A2. The frequency multiplier also produces an automatic load control (alc) voltage which limits the power level of the transmitter fixed head output. The output of the variable multiplier is selected in a tunable resonator which is ganged to XMTR TUNE front panel control. An impedance equalizer and a voltage controlled attenuator are also contained, in frequency multiplier 37A1, to control the output level of the multiplier. The alc voltage to operate the voltage controlled attenuator is derived from voltage regulator assembly 37AR1A1A1. The output

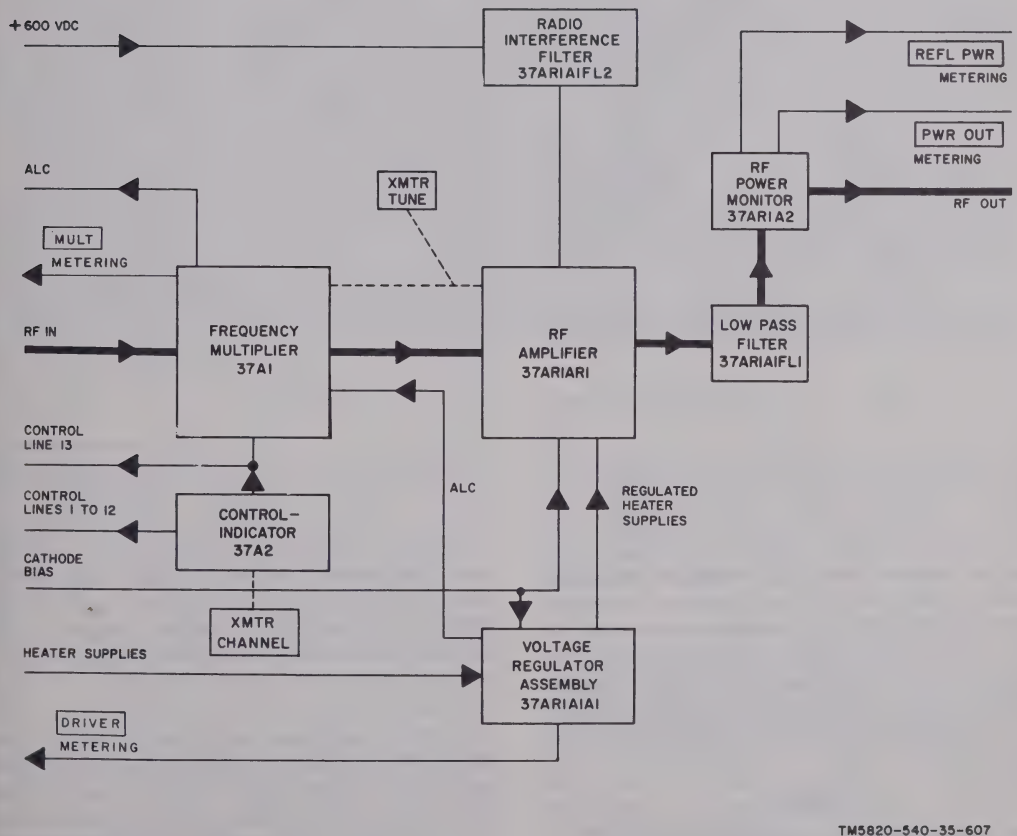


Figure 2–58. Band II transmitter RF head, block diagram.

of 37A1 in the range of 395 to 705 MHz, at a minimum level of 23 dbm, is fed into RF amplifier 37AR1AR1.

b. The amplification of the output signal to the final output level is done in two-stage radio frequency amplifier 37AR1AR1 (driver and output amplifier), using two planar triodes type 7211 mounted in tuned-cathode, tuned-plate coaxial quarter-wave resonant cavities. The XMTR TUNE control, on the front panel, tunes the cathode and plate plungers of both stages. Output coupling of the resonators is done by capacitive probes which are geared to the XMTR TUNE control. The probes are fine-tuned by the PWR OUT PEAK control. The tubes are cooled by forced air. Due to the concentric cavity design, maximum exposure of the plate radiators to the air stream is accomplished.

c. Radio frequency amplifier 37AR1AR1 amplifies the final frequency of the transmitter to a level of 30 to 40 watts. The amplified RF signal is then fed through low pass filter 37AR1A1FL1 for spurious harmonic suppression. After rejection of unwanted harmonics, the output signal is delivered through RF power monitor 37AR1A2 and the PWR OUT connector to amplifier-converter AM–4317/GRC–103(V) (band II receiver RF head), and through a duplexer, to the antenna system. A sample of output power and reflected power is rectified in the power monitor and taken out as REFL PWR and PWR OUT metering signals.

d. Control-indicator 37A2 (channel selector) is an electromechanical device operating in conjunction with electrical frequency synthesizer and amplifier monitor in the transmitter fixed head. The channel selector provides 13 control lines. Control lines 1 to 12 inclusive program the frequency generating circuits in the electrical frequency synthesizer. Control line 13 is fed through amplifier frequency multiplier to the transmitter fixed head to control variable attenuators in amplifier-monitor 5TR1A5. Voltage regulator assembly 37AR1A1A1 supplies the regulated heater supply for the driver and output tubes.

e. An overall schematic diagram of the band II transmitter RF head, amplifier-frequency multiplier AM–4321/GRC–103(V), is shown in figure 7–1, and interconnection diagram is shown in figure 7–2.

NOTES

1. In many of the schematic diagrams, triangular symbols, identified by "Z" numbers, are used. These are in accordance with USA Standard Y32.2–1967, Section 19, paragraph 15.1. They represent impedances introduced by ferrite beads, which are used extensively in certain sections of the receiver and transmitter RF heads for bands 2 and 3.
2. The words "END SEAL," inclosed in a rectangle, appear in several schematic diagrams. This symbol represents printed wiring board receptacles used with RG–188/U 50-ohm miniature coaxial cable. End seals are permanently soldered connections used to terminate the cable shield to ground. They may be of either straight or right-angle configuration.

2–57. Frequency Multiplier 37A1

a. General. Frequency multiplier 37A1 multiplies the transmitter fixed head signal by four or by six to provide the input drive for radio frequency amplifier 37AR1. Frequency multiplier 37A1 consists of two transistor stages on separate printed wiring boards with the transistors mounted on the cast aluminum housing. The first transistor stage 37A1A1 is a wideband frequency doubler and the second stage 37A1A2 is a variable frequency multiplier. The variable multiplier multiplies the doubled frequency by two or three as selected by a control signal from the control-indicator. The output frequency is selected in a tuned cavity filter which is ganged to the front panel XMTR TUNE control. The output level of the unit is automatically controlled by a signal from radio freuqnecy amplifier 37AR1. The unit is contained in two precision cast aluminum housings. The major casting incorporates the tuning cavity as an integral part of the casting. The smaller casting supports the electrical connector and filters. The cavity is tuned by a variable capacitor mounted within the cavity (fig. 2–59). An antibacklash spring is fitted on the end of the capacitor rotor hub to reduce backlash. The XMTR TUNE control is coupled through a flexible shaft, worm, and worm gear to the capacitor rotor.

b. Block Diagram Analysis (fig. 2–60). The output of amplifier frequency multiplier 5TR1A4, in the range of 95 to 145 MHz at a level of +35 dbm ± 1 db, is fed through the input matching network to the A1Q1 broadband doubler circuit. The RF power transistor A1Q1, amplifies the

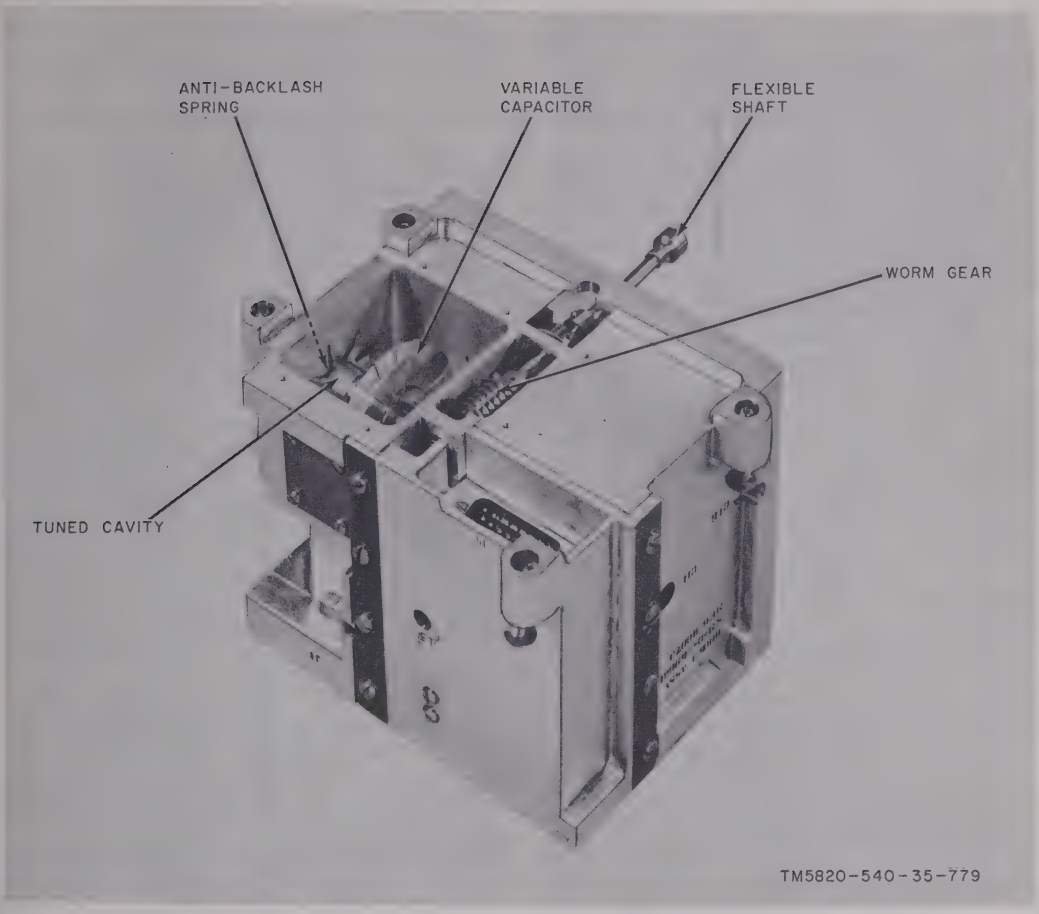


Figure 2-59. Frequency multiplier 37A1, bottom view.

input fundamental frequency while the collector to base capacitance acts as a varacter for harmonic generation. A portion of the RF input is fed to an alc circuit where the signal is rectified. The dc signal, proportional to the RF input, is fed back to the transmitter fixed head to maintain the RF input at the required level. The output of the wideband doubler is fed through an output matching network to the diplexer filter which terminates the fundamental frequencies and provides a path for the second harmonics. The output of the diplexer filter is applied to variable frequency multiplier transistor A1Q2 through the input matching network. The output of the variable frequency multiplier is a signal rich in second harmonics. When third harmonic frequencies are required, control line 13 turns on transistor Q2 in the switching circuit, which then forward biases switching diode CR1. CR1 switches in an idler circuit which allows the second harmonics to mix with the fundamental frequency to produce third harmonic frequencies. The frequency multiplier output is fed to the tunable filter which is ganged to the front panel XMTR TUNE control. The filtered signal is fed to the constant impedance equalizer which reduces the amplitude at the low frequency end of the signal. The equalized signal is fed to the variable attenuator which controls the output level. The alc voltage, from the voltage regulator in RF amplifier 37AR1, is amplified by dc amplifier Q1 and used to control the variable attenuator. The output of the attenuator is

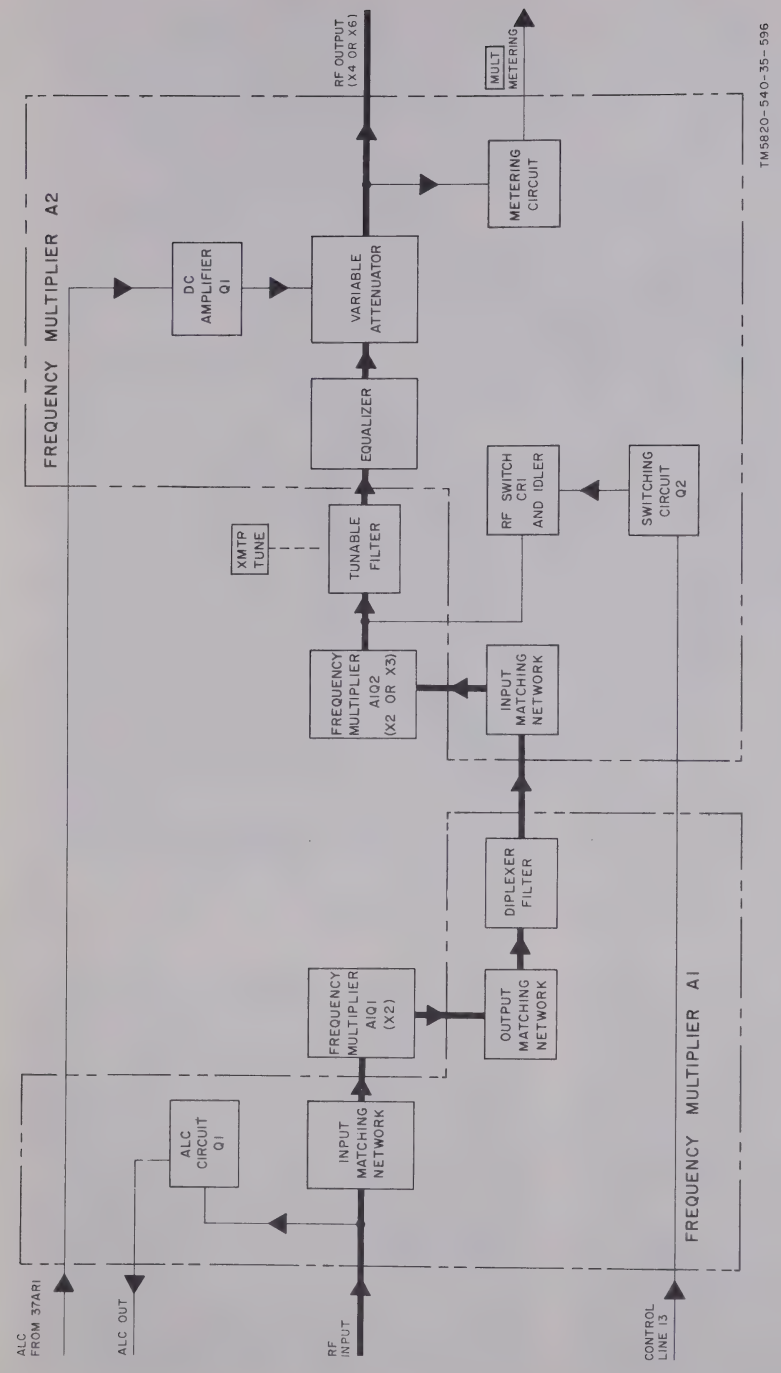


Figure 2-60. Frequency multiplier 37A1, block diagram.

coupled to the output connector and fed to the RF amplifier 37AR1. A portion of the output signal is fed into the metering circuit where it is rectified and used as the MULT metering signal.

c. Detailed Circuit Analysis (fig. 7-3).

(1) *Alc circuit.* A portion of the input RF signal applied to connector J1, is coupled through capacitor C1 to voltage divider R1, R2 and diode CR1 of the alc circuit. Normally CR1 is zero biased and is not conducting. The input signal fed through voltage divider R1, R2 provides approximately 5.1 volts peak-to-peak riding on 28v dc. On the negative peaks of this signal, CR1 is forward biased thereby charging C3 to approximately 23 volts (28.0 —5.1 volts). This in turn causes Q1 to conduct. The base current required to turn on Q1 is determined by R3 which is adjusted to give approximately 8.5 volts at E4. This voltage is used to operate the alc system in the transmitter fixed head. R4 is used to prevent the 28 volts dc from being applied to the emitter of Q1 if R3 is set to zero ohm. C2, C4 are RF decoupling capacitors. C5 is a feedthrough capacitor and prevents RF interference with the power supply line. R5 is the Q1 collector load.

(2) *Wide band doubler.* The RF input to A1Q1 transistor multiplier is fed through an input matching network. The input matching network contains a bandpass network and an impedance transforming network. The bandpass network consists of C6, L1, C7, and L2, and is used to isolate the input driver stage from the multiplier output frequencies. The parallel resistive network R6 and R7, in series with 4:1 transformer T1, matches the input impedance of A1Q1. The fundamental frequency, from the input matching network, is coupled through dc blocking capacitor C8 to the base of A1Q1. R8 provides a small reverse bias on the base of A1Q1 for optimum efficiency. The 20-volt dc collector supply, for A1Q1 and A1Q2, is derived from the +28v dc line by Zener diode CR1. L3 resonates the transistor output capacitance at the fundamental midband frequency while C9 provides a ground return through L3 to decouple the fundamental current. The capacitance between the base and collector of A1Q1 varies nonlinearly with the transistor collector voltage. The transistor amplifies the fundamental which drives the variable base-collector junction capacitance, producing a highly distorted output waveform. This waveform contains components of the fundamental and harmonic frequencies. The A1Q1 output is fed through output matching network C11 and L4 to the diplexer filter.

(3) *Diplexer filter.* The diplexer filter is a power splitter providing a path to terminate the fundamental frequencies at one port and a path for the second harmonics at the third port. The diplexer is a combination low pass-high pass filter with seven sections. The fundamental frequencies are fed through the filter and terminated in R1. The second harmonics, fed through the filter to the outer port, are coupled through C18 to the variable frequency multiplier 37A1A2 circuit.

(4) *Variable frequency multiplier.* The output of the frequency doubler is fed to the base of frequency multiplier A1Q2 through an input impedance matching network. The input matching network provides an input vswr of 2:1 maximum. R1 and R2 are used to increase the resistive component of the input impedance to facilitate wideband matching. The output at the collector of A1Q2 is the signal rich in second or third harmonics. L3 and C8 form an idler circuit which resonates with the collector to base varactor capacitance at midband of the fundamental input frequencies to produce second harmonic frequencies. L4 and C16 are switched into the collector circuit to allow the second harmonic current to flow through the varactor capacitance to produce third harmonic frequencies. R4 at the collector provides a resistive load to the fundamental frequency power. The 20v dc supply from zener diode CR1 is decoupled by feed through capacitor C9.

(5) *Switching circuit.* When third harmonics are required, transistor Q2 is turned on by +26 volts from control line 13. CR1 is forward biased by Q2 conducting, and idler circuit L4 and C16 is switched into the collector circuit of multiplier A1Q2. When second harmonics are required, transistor Q2 is turned off by a ground on control line 13. CR6 increases the minimum turn-on voltage of Q2 to over 1 volt to insure that Q2 turns off. When Q2 is turned off, CR1 is reverse biased and cuts off the third harmonic idler circuit.

(6) *Output matching network.* The output of the variable frequency multiplier is coupled through C14 to cavity filter Z1. The cavity filter is a coaxial line cavity capacitively tuned by air-dielectric variable capacitor C1. The tuning of the variable capacitor is done by the front panel XMTR TUNE control. Inductors L1 and L2 provide input and output coupling respectively, for constant bandwidth over the multiplier frequency

range. From Z1, the output signal is fed through a constant impedance equalizer and then coupled to PIN diode attenuator CR2, CR3, and CR4.

(7) *Constant impedance equalizer.* The output power of the frequency multiplier is greater at the low frequency end than at the high frequency end. It is possible for the maximum power at the low frequency end to be +31 dbm, while the power at some higher frequency is +25 dbm. The alc controlled PIN diode attenuator CR2, CR3, CR4 cannot handle such high power due to partial rectification effect at high level operation. The constant impedance equalizer, R10, R11, R12, L5, C17, levels the output power so that the maximum power at the lower frequency end is reduced to +27 dbm while at the higher frequency end the maximum is maintained at +23 dbm. The equalized signal is coupled through C18 to the output attenuator.

(8) *Output automatic level control.* An alc positive voltage from power amplifier 37AR1, proportional to the input signal to 37AR1, is applied to the base of dc amplifier Q1 through C26 and R16. C25 and C26 decouple any RF that enters the Q1 base region. R16 presents a high dc resistance to the alc voltage source. C24 is used for RF decoupling at the collector and R14 is the collector load. R15 stabilizes the dc voltage gain of Q1. The output loading of the transistor is essentially 1.8 kilohm and the maximum output voltage is approximately +14v dc without alc. As the alc voltage rises, the output voltage of Q1 collector will drop. The output of the dc amplifier Q1 is fed to the PIN diode voltage controlled attenuator CR2, CR3, CR4 connected in a "T" network. Voltage divider R5, R6, across the 28-volt supply, provides a reference voltage for the attenuator. When Q1 output voltage is high (minimum alc voltage), CR3 and CR4 are forward biased and produce a voltage drop across R7. The voltage across R7 is higher than the reference voltage, hence CR2 is reverse biased and turned off. The attenuation on the signal through CR3 and CR4 is minimal. As the alc voltage increases, the Q1 output voltage decreases, reducing the forward bias on (and current through) CR3 and CR4 until the voltage drop across R7 is less than the reference voltage. The reduced voltage drop across R7 forward biases CR2 which begins to conduct. The CR2 current flows through R7, CR3, and CR4 toward the dc amplifier, thereby increasing the attenuation of CR3 and CR4. In the extreme case, CR3 and CR4 are turned off when Q1 collector voltage drops to zero. C18, C27, C12, and C11 are dc blocking capacitors and L6 and L7 are RF chokes for dc paths.

(9) *Metering circuit.* A portion of RF is coupled to a directional coupler composed of two striplines on the printed circuit board. Since the coupling energy increases with increasing frequency, coil L8 is placed in series with detector diode CR5 to provide a constant RF drive to the diode. RF decoupling is provided by C13. The detected RF is fed to the metering circuit in the transmitter fixed head for MULT meter indication.

2-58. Radio Frequency Amplifier 37AR1AR1

a. General. Radio frequency amplifier 37AR1AR1 amplifies the final transmitter frequency in the frequency range of 395 to 705 MHz to a level of 30 to 40 watts. The amplifier consists of two grounded-grid triode stages in cascade. The two stages of the amplifier are of identical construction. Each stage uses a planar triode type 7211 electron tube mounted in tuned-cathode, tuned-plate coaxial quarterwave resonant cavities. The cathode and plate resonators are tuned simultaneously, over the frequency range, by moving mechanically coupled plungers, ganged to the XMTR TUNE control on the front panel. Output coupling of the resonators is by capacitive probes which are also ganged to the XMTR TUNE control. Peaking of the amplifier output (output probe) is accomplished by adjusting the PWR OUT PEAK control on the front panel. A trimmer capacitor within the plate resonator is used to compensate for tube plate-to-grid capacitance differences.

b. Cavity Construction and Tuning Mechanism (fig. 2-61). The heater connection to the amplifier tube is made through the hollow cathode lead screw inside the center conductor of the cathode-grid resonator. The lead screw is of a double-start nature to enable rapid transit of cathode tuning plungers. Cathode feed is taken through the input connector which is adjacent to the gear plate. This input signal is then passed through a 50-ohm coaxial feeder cable, firmly bonded to the outside of the grid-cathode resonator cavity, and fed through the cathode contact assembly to the cathode. Dc isolation is achieved within the cathode contact assembly. The plate supply is decoupled by a capacitor (bypass capacitor assembly) integral to the amplifier tube socket. The capacitor is a silvered mica disc in a potted assembly. Dc power to the tube plate is fed to the high voltage connection mounted on the plate side of the bypass capacitor assembly. Plate and

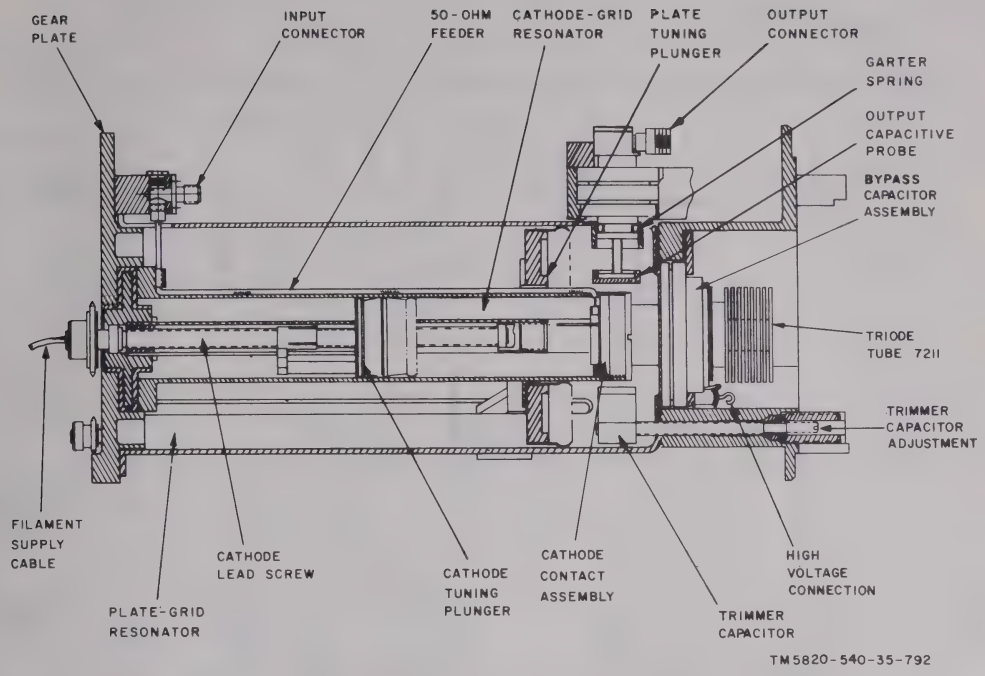


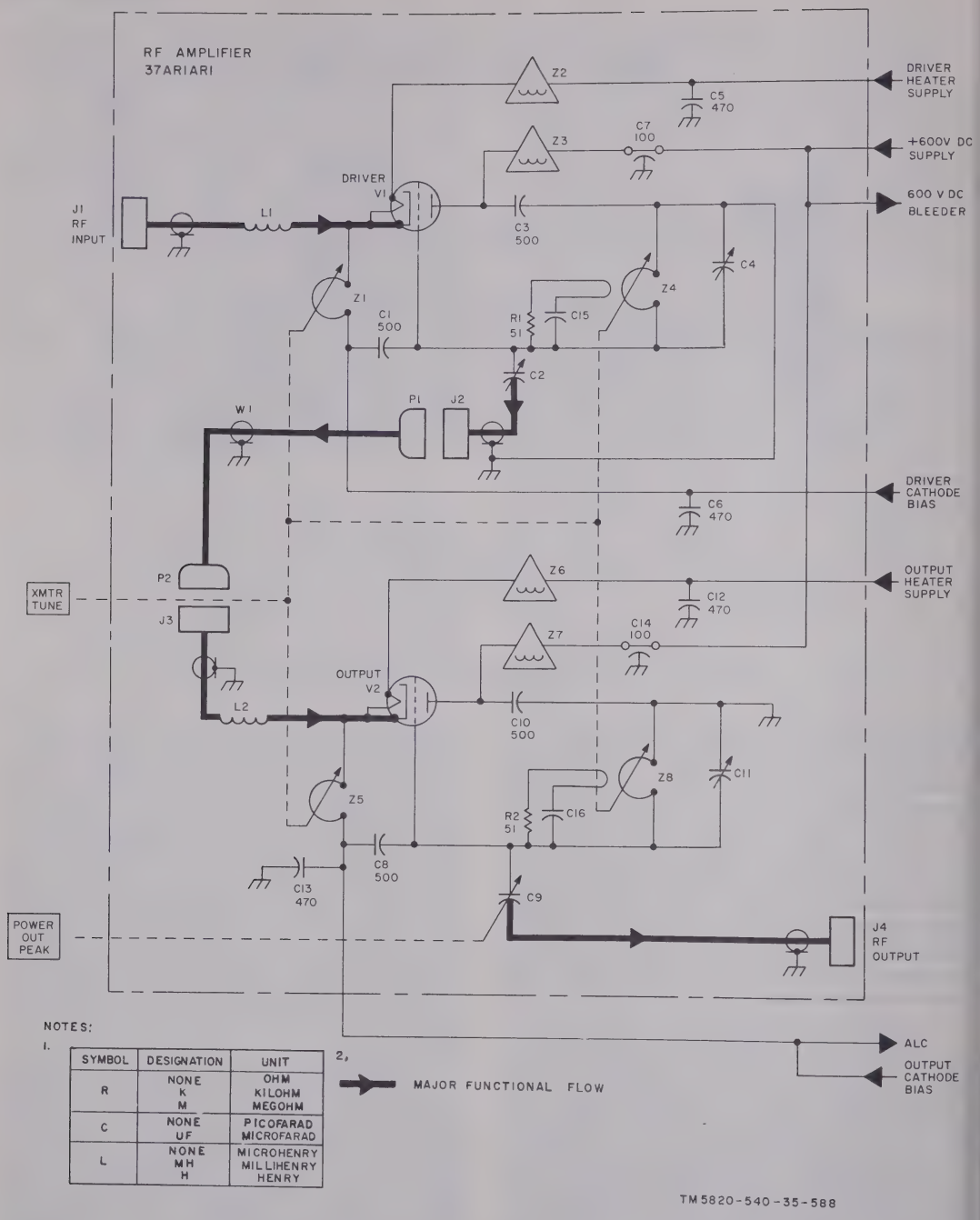
Figure 2–61. Power amplifier (band II) resonator cavity cross section.

cathode tuning is accomplished by varying the position of the respective short circuiting tuning plungers. The short circuit to the resonator walls is made through sets of flexible silver-plated fingers. The resonator frequency will increase as the short circuiting plunger is moved toward the tube. The output capacitive probe is located at the tube end of the plate-grid resonator and tracks with the resonator tuning mechanism. The PWR OUT PEAK control overrides this mechanical tracking to permit final probe positioning for optimum output power.

c. Detailed Circuit Analysis (fig. 2–62).

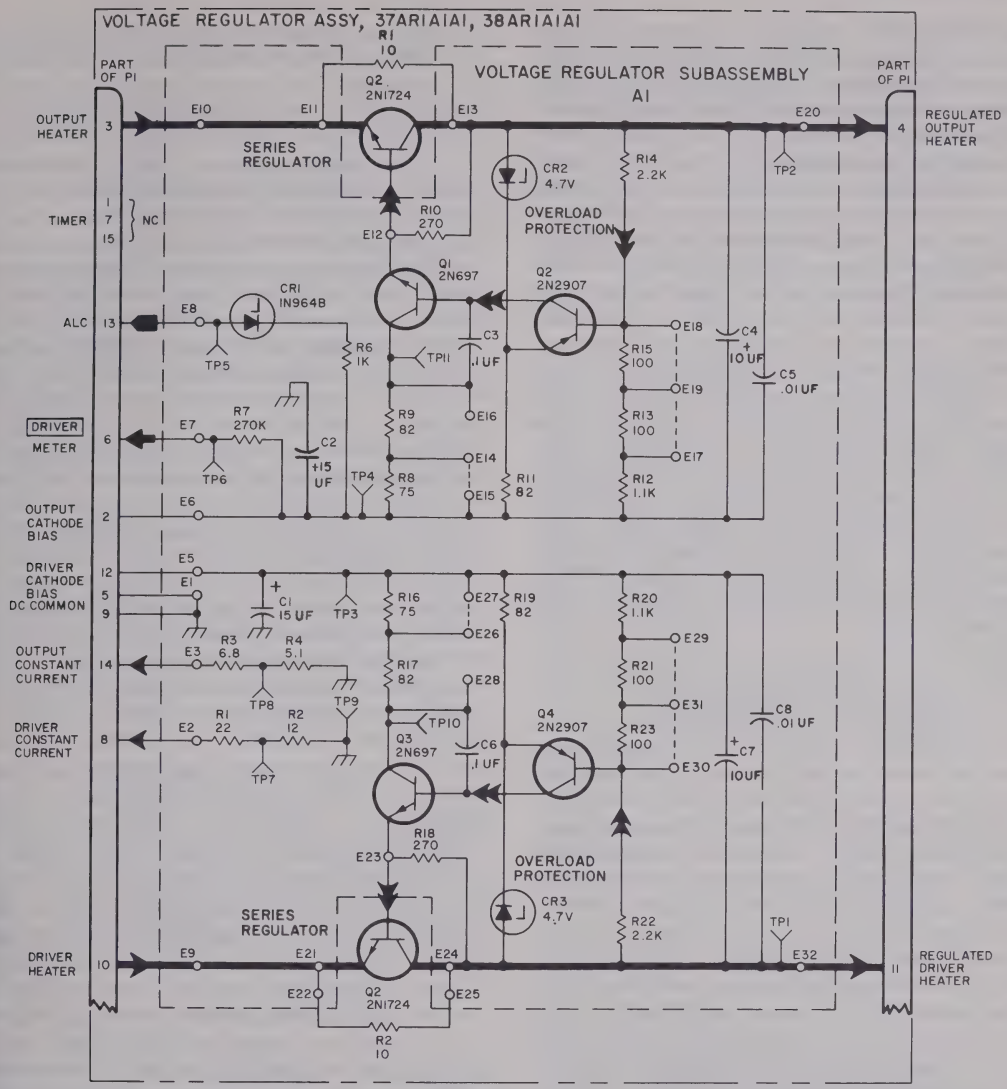
(1) The output of frequency multiplier 37A1, in the frequency range of 395–705 MHz, is fed through input connector J1 to the cathode of driver tube V1. Driver tube V1 and output tube V2 are identical and are connected in a grounded-grid configuration. Common grid configuration is used to minimize amplifier feedback effects due to triode interelectrode capacitance. Z1 and Z5 are cathode-grid resonant cavities; Z4 and Z8 are plate-grid resonant cavities for the driver and output stages respectively. C5 and C12 are feed-through capacitors for the regulated heater supply to the driver and output stages. C7 and C14 are the feed through capacitors for high voltage plate supply to both the stages. C1, C3 and C8, C10 are bypass capacitors and provide dc isolation. C4 is a trimmer capacitor in parallel with the plate-grid circuit and is used to compensate the electron tube plate-grid capacitance spread of the driver stage. C11 is the trimmer capacitor in the output stage. C15, R1 is a suppressor loop in the driver stage and C16, R2 is a suppressor loop in the output stage. These suppressor loops prevent any self-oscillation during mismatch conditions.

(2) The input signal when fed to the cathode of driver tube V1, excites cathode resonator Z1 connected between cathode and grid of V1. The signal, amplified by approximately 13 db at the plate of V1, resonates in Z4 (connected between plate and grid) and is coupled from the cavity to output connector J2 through the coupling probe C2. The output from the driver tube is connected through connector P1, coaxial cable W1, coaxial connectors P2 and J3 to the cathode of the output



SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

Figure 2-62. RF amplifier 37AR1AR1, schematic diagram.



NOTES 1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. MAJOR FUNCTIONAL FLOW.
SECONDARY FUNCTIONAL FLOW.
DC METERING FLOW.
FEEDBACK SIGNAL PATH.
REFERENCE SIGNAL VOLTAGE.

3. E17, E18 AND E19 ARE STRAPPED TO SET OUTPUT HEATER REGULATED VOLTAGE. E29, E30 AND E31 ARE STRAPPED TO SET DRIVER HEATER REGULATED VOLTAGE.

4. E14, E15 AND E16 ARE STRAPPED TO SET Q1 COLLECTOR VOLTAGE. E26, E27 AND E28 ARE STRAPPED TO SET Q3 COLLECTOR VOLTAGE.

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Figure 2-63. Voltage regulator assembly 37AR1A1A1 or 38AR1A1A1, schematic diagram.

stage V2. Output stage V2 is electrically and mechanically similar to the driver stage. The output cathode bias changes are fed to the heater voltage regulator assembly to produce an alc voltage for frequency multiplier 37A1. This alc voltage controls the output of the frequency multiplier (input to the power amplifier). The output stage provides a further amplification of about 10 db. The final amplified signal is fed through coupling probe C9 to output coaxial connector J4. Output coupling probe C9 is ganged to front panel controls XMTR TUNE and PWR OUT PEAK. Cathode currents are regulated by a constant current source within transmitter power supply 5TR1PS1. Plate supply for the tubes is 630 volts dc at about 180 milliamperes, and is supplied through radio frequency interference filter 37AR1A1FL2 which suppresses any 5-kHz components on the 630-volt supply. Resistor assembly 37AR1A1A2 bleeds off any residual high voltage when the unit is disconnected. Channel-frequency indicator DS1 is ganged to the XMTR TUNE control and provides a visual indication of the selected channel.

2–59. Voltage Regulator Assembly 37AR1A1A1 or 38AR1A1A1

a. General. The voltage regulator assembly regulates the heater supply voltages to the transmitter RF power amplifier tubes. It also provides an alc reference circuit, metering voltages, and two resistive paths which control the constant cathode current regulators in the transmitter fixed head power supply. The unit consists of the following functional circuits:

(1) Two identical heater voltage regulator circuits, one for the driver and the other for the output stage of the RF power amplifier.

(2) An alc reference circuit using the bias potential from the cathode of the output stage of the RF power amplifier as the input.

(3) A metering circuit for monitoring dc bias at the cathode of the output stage (DRIVER metering).

(4) Two resistive paths which form part of the driver and output constant cathode current circuits located in the transmitter fixed head power supply.

NOTE

Since the two heater voltage regulator circuits are identical, only the output stage regulator is explained in the following paragraph, together with the other circuits explained in *a*(2), (3), and (4) above.

b. Detailed Circuit Analysis (fig. 2–63).

(1) *Regulator circuit.* The 7.2v dc heater supply voltage from the transmitter fixed head power supply (fig 6–13) is fed to the emitter of transistor A1Q2 which acts as a series regulator controlling the output voltage at a constant value of 6.3v dc ±5 percent. Zener diode CR2 and R11 maintain the emitter potential of Q2 at a constant value with respect to the negative line of the regulator output. Q2 base voltage divider, R12, R13, R14, and R15, samples the output voltage. Any variation in the output voltage will cause the Q2 emitter-base voltage to vary, resulting in a corresponding variation in the collector current. These collector current variations are amplified in Q1 and used to control the base current of A1Q1, which causes the output of A1Q1 to change in such a way as to compensate for the change in output voltage and bring it back to the original value. The base voltage divider of Q2 is adjustable to compensate for component tolerances. The correct voltage division is required to obtain the specified output voltage limits of 6.3v dc ±5 percent. Capacitor C3, between the base and the collector of Q1, neutralizes any oscillation of the regulator circuit. Capacitor C4, shunted by capacitor C5, further stabilizes the circuit and suppresses any ripples or spikes at the output. Q1 collector resistors R8 and R9 provide short circuit current limiting. This resistance is made adjustable to achieve short circuit current limits in the range from 1.6 to 2.8A. Resistors R10 and A1R1 are the starting resistors. In the initial state of operation, the tube is cold and the filament resistance (load resistance) is so low that the output heater voltage drops below 2.5v dc, cutting off CR2. The Q1 collector current then reduces to its cutoff value. A1Q1 base current will then be effectively determined by R10 and the input voltage. R10 and A1R1 draw sufficient current, in this initial state, to heat up the filament. The regulator circuit operates normally after approximately 15 seconds. During normal operation, the current through R10 and A1R1 is minimal and regulation is not impaired.

(2) *Alc circuit.* The output cathode bias supply is connected to E6 and fed through current limiting resistor R6 to 13-volt dc Zener diode

CR1. R6 and CR1 stabilize the voltage between TP4 and TP5 at approximately 14v dc which is the normal cathode voltage level to the output tube. When this voltage increases, due to a higher input drive to the output tube, CR1 conducts. The resultant alc voltage is fed through P1 pin 13 to the frequency multiplier 37A1 or 38A1.

(3) *Metering circuit.* The metering circuit consists of resistor R7 and capacitor C2. The cathode bias is conneced through series resistor R7 to the front panel meter to indicate the cathode bias level of the power amplifier output stage. Smoothing capacitor C2 removes any ripple from the dc supply and smoothes out the bias variations due to frequency changes of the modulated signal.

(4) *Resistive paths for constant current supply.* R1 and R2 are connected in the emitter line of the constant cathode current source transistor (transmitter fixed head power supply) (fig. 6-13) for the driver stage. R1 and R2 effectively limit the maximum current in the emitter circuit. Test point TP7 is provided to measure the voltage level between the two resistors. This voltage level is used to determine the constant cathode current level. R3 and R4 form a similar arrangement for the constant cathode current of the power amplifier output stage.

2-60. Low Pass Filter 37AR1A1FL1

Low pass filter 37AR1A1FL1 is connected between the output of RF amplifier 37AR1AR1 and power monitor 37AR1A2. Low pass filter 37AR1A1FL1 is a sealed, high-power filter with a sharp cutoff above 1,000 MHz. It filters out any spurious harmonics of the transmitter output RF signal.

2-61. RF Power Monitor 37AR1A2 or 38AR1A2

RF power monitor 37AR1A2 or 38AR1A2 is connected between the low pass filter and the PWR OUT connector. The RF power monitor consists of two bidirectional couplers placed back-to-back in a sealed unit. One coupler monitors the output power of the transmitter and the other monitors the power reflected back to the transmitter. Both forward and reverse signals are rectified to produce dc metering signals. The forward power metering is fed to the meter through the selector switch in the PWR OUT position. It is also fed in parallel to alarm control 5TR1A3 (para 2-20). Alarm control 5TR1A3 will initiate a LOW POWER alarm if the transmitter output power should drop by 8 db to about 4 watts. A 5,000-ohm resistor is switched into the circuit when the meter selector swich is in any other position, so that the monitor signal will not be disturbed by switching the meter to the PWR OUT position. The reverse power metering signal is fed to the meter through the selector switch in the REFL PWR position. This metering function is used primarily to assist the operator while tuning the XMTR DUPL tuning control on the receiver RF head. Minimum meter reading indicates correct tuning of the transmitter position of the duplexer in the receiver RF head.

2-62. Control-Indicator 37A2 or 33A4

a. General. Control-indicators 37A2 (fig. 7-1) (transmitter channel selector) and 33A4 (receiver channel selector) are identical in function and construction and also similar to control-indicator 6A3 (fig. 2-38). Each channel selector provides 12 control lines (2 through 13) to the frequency synthesizer in the transmitter or receiver. To select the required synthesizer frequency, control lines 2 to 12 are switched on and off in a binary pattern with line 13 switched between channels 759 and 760 to change the synthesizer output frequency steps. The switching modules are operated by a set of cams and followers which reflect the various coding patterns as shown in the coding tables (fig. 7-4).

b. Description of Operation. The control-indicator consists of a set of 11 microswitches and a logic module (command signal decoder). The microswitches are operated by a set of cams to generate the binary code which presets the required stages of the programmed counter in synthesizer 5TR1A2 or 1RE1A2. The front panel channel-indicators consist of a series of numbered wheels. The indicating wheels are geared to the microswitch cams and to a front panel control knob. The transmitter channel selector display indicates the channel rather than the frequency selected. The following formulas should be used to translate a selected channel into a frequency and vice versa.

(1) Transmitter frequency $= \frac{\text{Transmitter Channel}}{2} + 200$ MHz.

(2) Transmitter Channel = (Transmitter frequency —200) $\times$ 2.

c. Receiver Coding. On the receiver channel selector the coding is arranged to produce a local oscillator frequency 30 MHz higher than the channel indicated in the display. This is done to

permit the indicator to refer to the received signal frequency, the actual local oscillator frequency being always 30 MHz higher to provide the correct intermediate frequency. The decoder unit is an encapsulated logic circuit designed to sense channel coding on the 11 microswitch output lines and initiate control line 13 switching to establish multiplication changeover, which takes place between channels 759 and 760 in the transmitter and channels 699 and 700 in the receiver.

Section VII. AMPLIFIER-CONVERTER AM-4317/GRC-103(V)

2-63. Functional Block Diagram Analysis of Amplifier-Converter AM-4317//GRC-103(V) (fig. 7-5)

a. Amplifier-Converter AM-4317/GRC-103(V) (band II receiver RF head) incorporates a duplexing system which enables the radio set to use a single antenna for both transmit and receive sections, and circuits which convert the incoming signal into a 30 MHz intermediate frequency.

b. Receiver RF head duplexer 33A1 provides the necessary isolation and impedance matching between the transmitted and received signals. The transmit signal at the PWR OUT connector of the transmitter RF head at a level of 25 watts is fed through an external RF coaxial cable, through the FROM XMTR connector on the front panel of the receiver RF head to duplexer subassembly 33A1A1. In the duplexer subassembly, the transmit signal is fed to a tuned two-cavity filter (resonator). The tunable transmit filter is manually tuned to the transmit channel by the XMTR DUPL control. The ±2-MHz bandwidth of the filter provides additional filtering of the transmitted signal while presenting a high attenuation to the received frequency. The transmitted signal is then directed through impedance matching network 33A1A1Z1 and RF power monitor 33A3 to the ANT. connector, and through an RF coaxial cable to the antenna system. RF power monitor 33A3 samples the forward and reflected RF power to and from the antenna system. These samples are rectified and the resulting dc voltages are used for XMTR DUPL and REFL PWR metering.

c. The receiving circuits of the receiver RF head accept modulated signals in the frequency range of 395 to 705 MHz, at a level of —54 dbm to —94 dbm and convert them to a 30 MHz intermediate frequency (IF) which is then amplified and demodulated in the receiver fixed head. The signals from the antenna, applied to the ANT. connector by the lead-in cable, are fed through impedance matching network 33A1A1Z1 to a 3-MHz bandwidth, tunable four-cavity filter (receiver section of duplexer subassembly). The tunable receive filter is manually tuned to the receive channel by the RCVR SIG control. The received signal is then fed through a high signal protection circuit (Signal Level Control-Monitor) which prevents RF signals greater than +15 dbm nominal from getting into the receiver. The signal level control-monitor also monitors the protection level and triggers the HIGH SIGNAL ALARM circuit when the input level at the antenna port exceeds +15 dbm.

d. The RF signals are fed through low pass filter 33FL1 which attenuates all harmonics of the incoming frequency. The output of the low pass filter is fed into the frequency mixer stage 33A7. The frequency mixer stage consists of two subassemblies, radio frequency amplifier 33A7AR1 and frequency mixer stage 33A7A1. The radio frequency amplifier contains a voltage-tuned bandpass filter which tracks with the receiver section of the duplexer and rejects image frequencies. The radio frequency amplifier 33A7AR1 has a nominal gain of 13.5 db, including the filter loss, over the frequency range of 395 to 705 MHz. The amplified signal is fed into the frequency mixer stage 33A7A1 where the received RF signal is mixed with the local oscillator signal to produce the 30 MHz IF. The frequency mixer stage 33A7A1 consists of a wideband balanced mixer with a nominal conversion loss of 7 db and a local oscillator metering circuit.

e. The input to frequency multiplier group 33A2 is the output of amplifier-frequency multiplier 1RE1A5, in the range of 95 to 145 MHz. The frequency multiplier group 33A2 consists of three modules, frequency multiplier 33A2A2, frequency multiplier 33A2A1 and bandpass filter 33A2FL1. Frequency multiplier 33A2A2 doubles the input frequency from 1RE1A5. The resultant frequency from 33A2A2 is applied to the second module, frequency multipler 33A2A1, which doubles the frequency over one portion of the band and triples it over the remaining portion, to produce a continuously variable output frequency 30 MHz above the frequency of the received signal. Mechanically, frequency multiplier 33A2A1 is ganged to the RCVR SIG control, which also drives band-

pass filter 33A2FL1, the third module of the frequency multiplier group. Bandpass filter 33A2FL1 attenuates the unwanted submultiples of the output frequency from the frequency multipliers. The RCVR SIG control adjusts variable frequency multiplier 33A2A1 and bandpass filter 33A2FL1 to a point near the required tuning point, approximately 30 MHz above the frequency of the received signal. The MULT PEAK control then tunes the variable frequency multiplier and the bandpass filter to the required tuning point. The ganging of the RCVR SIG and MULT PEAK is such that the output frequency from frequency multiplier group 33A2 (local oscillator) is always 30 MHz above the duplexer receiver section. The local oscillator signal is then fed into frequency mixer stage 33A7A1 where it is amplified and then mixed with received RF signal to produce a 30-MHz IF signal. A portion of the local oscillator signal is detected and rectified in frequency mixer stage 33A7 to provide the MULT metering voltage. The IF signal from the mixer stage is amplified in intermediate frequency amplifier 33AR1. Intermediate frequency amplifier 33AR1 is part of the IF amplification system which also includes bandpass filter 1RE1FL1 and intermediate frequency amplifier 1RE1AR2 in the receiver fixed head. Intermediate frequency amplifier 33AR1 has a nominal gain of 50 db without agc and a maximum gain of 10 db with maximum agc. Automatic gain control of two stages in each of the two IF amplifiers provides automatic adjustment of overall gain over a range of 50 db, depending on the input signal. Intermediate frequency amplifier 33AR1 is a broadband device, all shaping being done in bandpass filter 1RE1FL1 (para 2-41).

f. Operating voltages, +12v and —12v regulated and 26v unregulated, required for the circuits in the receiver RF head, are supplied by power supply 1RE1PS1 in the receiver fixed head.

An overall schematic diagram of the BAND II receiver RF head is shown in figure 7-6 and the interconnecting diagram is shown in figure 7-7.

2-64. Duplexer Subassembly 33A1A1

a. General. Since Radio Set AN/GRC-103(V) operates with a single antenna, duplexer subassembly 33A1A1, part of duplexer 33A1, provides the necessary isolation between the transmitted signal and the received signal. The duplexer subassembly, basically, consists of two coaxial cavity filters with a common port (ANT. connector); one filter provides filtering of the transmitter signal and the other filters the received signal. The duplexer subassembly also contains an impedance matching network 33A1A1Z1 which matches the transmit and receive filters to the antenna over the entire frequency range; S1 is a shorting device used during the alignment of transmit cavity Z7 and receive cavities Z2, Z3. In addition to the cavity filters and impedance matching network, the duplexer subassembly also contains the gearing and mechanical drive for the voltage control assembly 33A1A2 and frequency multiplier group 33A2. The chassis of the duplexer subassembly is the main structural member of the amplifier-converter AM-4317/GRC-103(V).

b. Detailed Circuit Analysis (fig. 7-6).

(1) *Transmitting path.* The transmitter portion of the duplexer subassembly consists of two quarter-wave resonant tuned cavities, 33A1A1Z6 and 33A1A1Z7. The cavities are connected in series through an intercavity coupling network. The coupling network provides the correct impedance transformation between adjacent resonators for realization of proper filter response. Both cavities are tuned in parallel with adjustable plungers controlled by the XMTR DUPL front panel control. The channel to which the transmitter cavities are tuned is indicated by channel-frequency indicator 33A1A1DS2 in the XMTR CHANNEL display window. The input and output of the resonators are connected through the end resonator coupling networks which transform the 50-ohm impedance of the system up to the correct level required by the resonators, for realization of the proper filter response. The filter has a passband of ±2 MHz and an insertion loss of 1.5 db for 90 percent of the band and 2.0 db for the remainder. The output of the filter, from the end resonator coupling network, is fed to the impedance matching network 33A1A1Z1 which matches the impedance of the transmitter to the antenna. The transmitter output is then fed through power monitor 33A3 to the antenna. Power monitor 33A3 measures the forward and reverse (reflected) power of the transmitted signal. Spark protection during tuning is afforded the cavities by spark gaps E2 and E4.

(2) *Receiving path.* The received signal from the antenna is connected through power monitor 33A3 and impedance matching network 33A1A1Z1 to the end resonator coupling network of the receiver cavity filter. The receiver portion of the duplexer subassembly consists of four quar-

ter-wave resonant tuned cavities, 33A1A1Z2 to 33A1A1Z5. The cavities are connected in series through intercavity coupling networks. Spark protection during tuning is afforded the cavities by spark gaps E1, E3, E5 and E6. The coupling networks provide the correct impedance transformation between adjacent resonators. All four cavities are tuned in parallel by adjustable plungers controlled by RCVR SIG front panel knob. The channel to which the receiver cavities are tuned is indicated by channel-frequency indicator 33A1A1DS1 in RCVR CHANNEL display window. The receiver filter has a pass band of ±3 MHz and an insertion loss of 2.0 db for 90% of the band and 2.5 db for the remainder of the band. The input and output of the resonators are coupled through end coupling networks which provide the correct source and termination impedance for the filters.

(3) *Coupling networks.* A coupling network between two adjacent resonators is provided to give the correct impedance transformation. The required characteristics are achieved by using a T-network of L–C circuits. These coupling networks between resonators Z1, Z3, Z4 and Z5, in the receive section, are identical except for the value of their components. A typical coupling network, such as that between resonator Z2 and Z3 consists of a series inductor L4 in parallel with variable capacitor C5, a series inductor L8 in parallel with variable capacitor C6 and a variable shunt inductor L6. Z11 in parallel with L6 is the stray capacitance existing between the coils when located in their housing. The coupling network between resonator Z6 and Z7 in the transmit section consists of series inductors L3, L7 and a variable shunt inductor L5. Z10 in parallel with L3 is the stray capacitance of L3 and similarly Z12 and Z13 are stray capacitances of L5 and L7 respectively.

(4) *End resonator coupling network.* The input and output end resonators of the receive and transmit filters are terminated in special coupling networks. These networks transform the 50 ohm impedance of the system up to the correct level required by the resonators. The input network in the receive filter consists of a variable inductor L2 in parallel with Z9. Z9 is the capacitance of the coil. A similar network at the output consists of variable inductor L16 and parallel capacitor Z17. The input and output networks in the transmit section are similar except that the inductors are fixed, but the capacitance due to these fixed inductors can be varied.

(5) *Impedance matching network 33A1A1Z1.* This unit provides a common junction for the transmit and receive filters. The network consists of a Tee-junction. One arm is a 50-ohm transmission line which terminates at the duplexer connector J1 and the other two arms of the tee are identical, 100-ohm transmission lines. The two 100-ohm arms are connected in series with their respective filter at the resonator coupling network coil. The electrical length of these two arms changes with the on-tune and off-tune frequencies and thereby maintains the proper match between transmit and receiver filters to the antenna over the entire frequency range of 390 to 705 MHz.

(6) *Tuning mechanism.* The tuning of duplexer subassembly 33A1A1 and variable frequency mutiplier 33A2A1,

is accomplished through two main shafts mounted on the duplexer chassis. One shaft tunes the transmitter section of the duplexer subassembly and the other shaft tunes the receiver section of the duplexer subassembly and the frequency multiplier. The transmitter section drive shaft, connected to the XMTR DUPL control through reduction gears (fig. 2–64), carries three bevel gears. Two bevel gears drive the two individual center conductor drive screws of the resonant cavities and the third gear drives the XMTR CHANNEL indicator. Similarly, the receiver drive shaft, connected to the RCVR SIG control through reduction gears (fig. 2–65), carries five bevel gears. Four bevel gears drive the four individual center conductor drive screws of the receiver resonant cavities. The fifth gear drives the channel frequency indicator RCVR CHANNEL. Also carried on the receiver section drive shaft are two reduction spur gears, one of which drives the speed decreaser gear assembly. The speed decreaser gear assembly provides tracking between the receiver duplexer cavities and the frequency multiplier and at the same time permits a small adjustment of the frequency multiplier, relative to the receiver duplexer, using the MULT PEAK control. The second spur gear on the receiver drive shaft provides a coupling to voltage control assembly 33A1A2. The voltage control assembly provides the tuning voltage for a varactor filter in frequency mixer stage 33A7.

c. An interconnection diagram of the band II receiver RF head is shown in figure 7–7.

2–65. RF Power Monitor 33A3 or 34A3

RF power monitor 33A3 or 34A3, located in the receiver RF head, is fitted in the antenna line,

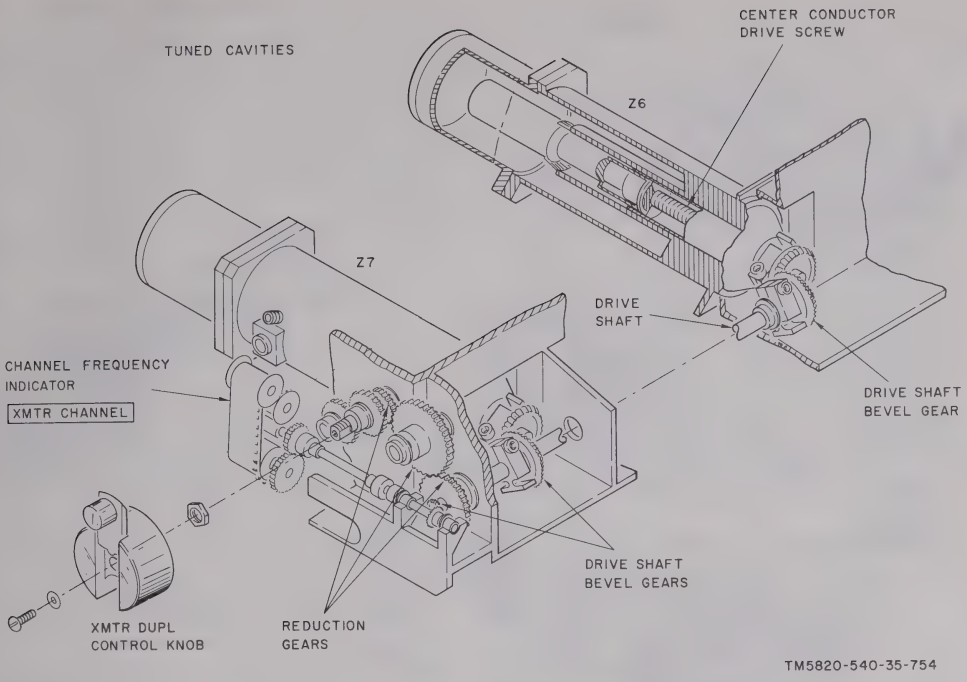


Figure 2–64. Duplexer subassembly 33A1A1 or 34A1A1 transmitter section tuning mechanism.

between impedance matching network 33A1A1Z1 or 34A1A1Z1 and the antenna connector (ANT.) on the front panel of the receiver RF head. The power monitor consists of two directional couplers, placed back-to-back with integral detectors and temperature compensation circuits. It samples the output power from the antenna, rectifies the RF signals and feeds the resulting dc voltages to the meter on the front panel of receiver fixed head. This provides appropriate meter readings when the meter switch is in either the XMTR DUPL or REFL PWR position.

2–66. Signal Lever Control-Monitor 33A5 or 34A5

a. General. Signal level control-monitor 33A5 or 34A5 protects the receiver low noise amplifier circuitry, contained in frequency mixer stage 33A7 or 34A7, against possible high-level signals coming into the receiver from the antenna or transmitter terminal. Protection is obtained by presenting a low impedance to high-level signals, hence reflecting the unwanted RF power. The output of duplexer subassembly 33A1A1 or 34A1A1 is connected to input connector J1 and the output is taken from connector J2 and fed to low pass filter 33FL1 or 34FL1. Operating voltages are connected to the unit through 9-pin connector P1. The unit also monitors the protection level and triggers an alarm circuit. The alarm circuit is located in the radio receiver and is connected to audio and visual indicators.

b. Detailed Circuit Analysis (fig. 7–8).

(1) *Signal level limiter 33A5A1 or 34A5A1.* The RF input signal, from the receiver section of duplexer subassembly 33A1A1 or 34A1A1, is connected to connector J1. The signal is coupled through C1 into RF level limiter A1, along the stripline, to which the shunt attenuator CR1, RF limiter A1, and clippers CR2 and CR3 are connected. When the input signal level is —5 dbm or less, the signal travels through the stripline from J1 to the output J2, with only negligible insertion loss introduced by the stripline. If the level of the input signal increases to 0 dbm the two hot-carrier diodes, CR2 and CR3, start clipping the peaks of the RF signal. When the level of

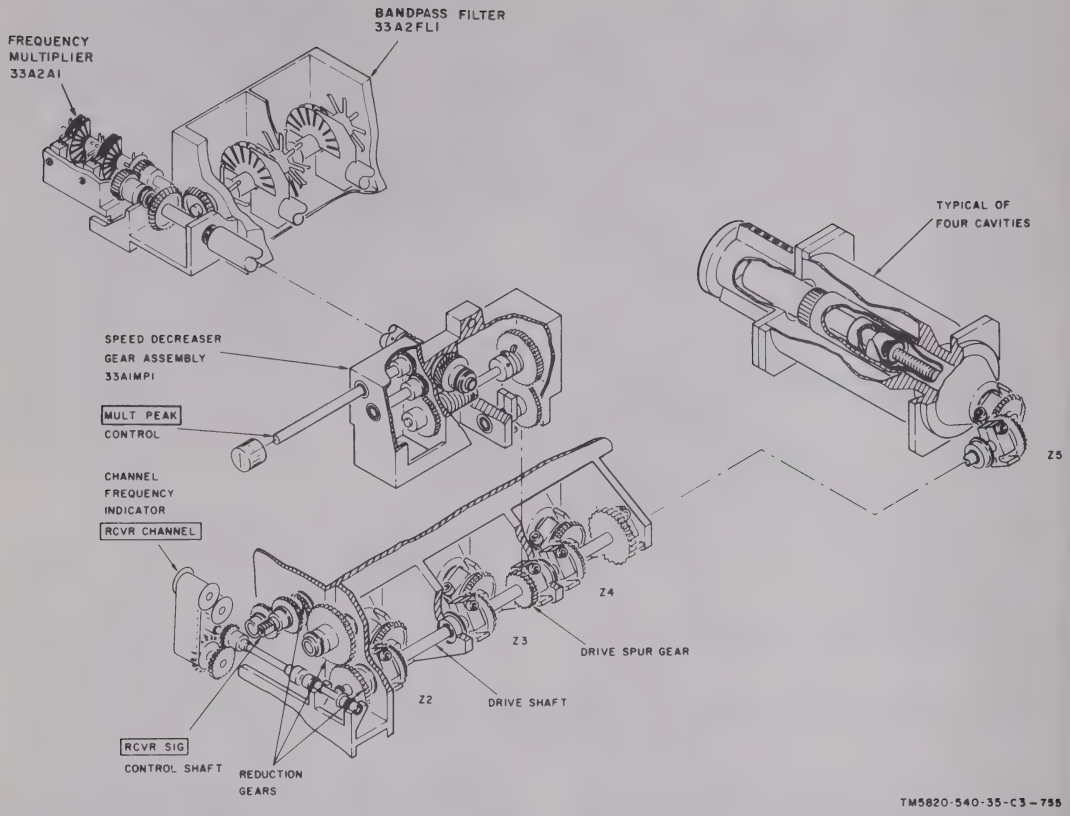


Figure 2-65. Duplexer subassembly 33A1A1 receiver section tuning mechanism.

the input signal reaches +10 dbm, RF limiter A1 starts generating dc current which flows to ground. The dc current increases proportionally with the level of the RF signal incident on A1. Shunt attenuator CR1 and RF limiter A1 are dc blocked within the same section of the stripline and therefore CR1 acts as a dc return for the dc current from A1. CR1 is a PIN diode and the dc current acts as a forward bias to the diode providing a low shunt impedance to the RF signal; this results in attenuation of the signal. The response time of the circuit is very low and therefore high amplitude input signals are limited almost instantly.

(2) *Alarm control 33A5A2 or 34A5A2.* The negative dc voltage from the cathode of CR1 in signal level limiter A1 is fed through L1 and feedthrough capacitor FL3 and applied to the base of Q1 in alarm control A2. The voltage at the emitter of Q1 is adjusted to approximately +0.2 volt by voltage divider R2, R3, and R6. ALARM LEVEL potentiometer R3 sets the operate point for the HIGH SIGNAL ALARM circuit by setting the voltage at the emitter of Q1. When the negative voltage at the base of Q1 increases to approximately —0.4 volt, Q1 starts conducting, thereby turning on Q2 and Q3. Q3 emitter-collector current flows through the HIGH SIGNAL ALARM relay, in the receiver fixed head, causing it to operate. R6 in the collector circuit of Q3, is a latching resistor which eliminates chattering of the alarm circuitry. CR1 is connected across the alarm relay circuit and suppresses switching spikes. When Q3 is conducting, the collector current causes a voltage drop across R6 thereby raising the voltage level at the tap of R3. This increased voltage at the emitter of Q1 makes it conduct more. Resistor R4 and R5 provide a path for the leakage currents in Q2 and Q3.

2-67. Low-Pass Filter 33FL1

Low-pass filter 33FL1 is a sealed unit connected between signal level control 33A5 and frequency mixer stage 33A7. It is used to suppress the harmonics of the incoming frequencies and provides a minimum of 35 db rejection at all frequencies above 1185 MHz (3 times the lowest fundamental). The VSWR at either port does not exceed 1.31:1 and the power handling capacity is 25 dbm continuous.

2-68. Frequency Mixer Stage 33A7

a. General. The frequency mixer stage consists of the following four separate integrated circuit subassemblies, soldered to a printed circuit board 33A7A1: RF amplifier 33A7A1AR1, integrated circuit (I/C) monitor-power 33A7A1A1, two balanced mixers 33A7A1A2 and 33A7A1A3, and a hybrid quadrature 3-db coupler 33A7A1HYB1 (IF). The monitor-power, the two balanced mixers, and the quadrature hybrid IF are part of the image rejection mixer circuit. The received RF signal in the range of 395 to 705 MHz from the low-pass filter 33FL1, and the local oscillator signal between 425 and 735 MHz from the band-pass filter 33A2FL1 are mixed in the two balanced mixers; the resultant 30 MHz IF outputs are then fed to the IF amplifier 33AR1. Conversion gain of the frequency mixer stage 33A7 is between 10 and 18 db, while the noise figure is below 3.6 db.

b. Circuit Description (fig 7-9). The RF input at 33A7J1 is applied to pin 1 of the RF amplifier 33A7A1AR1. The two-stage, low-noise, broadband amplifier is a microwave integrated circuit using high-gain, low-noise microwave transistors in their co-planar stripline package; fabrication of the RF amplifier on an alumina substrate using thin-film technology provides a good control of assembly parasitics. The gain of the RF amplifier is 19 $\pm$ 2 db with a noise figure of 2.8 db. +12v dc and -12v dc operating voltages are applied to pins 3 and 2 of the RF amplifier; FL1 and FL2 provide RF filtering of the dc lines.

(1) Integrated circuit (I/C) monitor-power 33A7A1A1 combines the function of a 3-db coupler, an in-phase power divider, and a power monitor. The RF signal at pin 4 of the RF amplifier is applied to the 3 db coupler assembly (RF quadrature hybrid) (fig 2-66). The two RF outputs in quadrature phase are applied through pins 7 and 2 (fig 7-9) to balance mixers 33A7A1A2 and 33A7A1A3 respectively.

(2) The local oscillator signal is applied through pin 4 of I/C monitor-power to an in phase hybrid power divider; the two resultant local oscillator outputs are then applied in-phase through pins 3 and 6 to the two balanced mixers. The

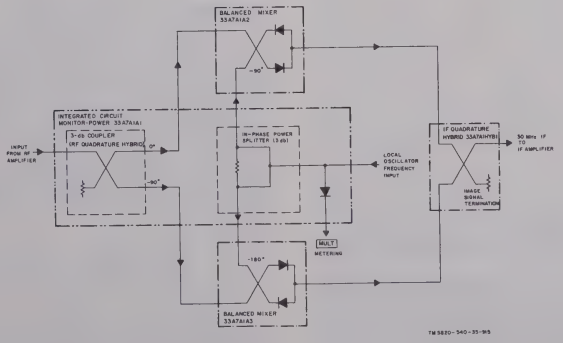


Figure 2-66. Frequency mixer stage 33A7, block diagram.

RF voltage of the incoming local oscillator signal is detected and the dc voltage is made available through pin 5 to output connector P1 pin 4 for MULT metering. Like the RF amplifier 33A7A1 AR1, the monitor power is a microwave integrated circuit realized by using thin film technology on alumina substrate.

(3) The two balanced mixer stages provide products ±30 MHz around the local oscillator frequency. The two mixers are identical, only the pin numbers are different; the balanced configuration of the mixers provides optimum spurious rejection.

(4) The two IF signals are then quadrature coupled within the 3-db coupler quadrature hybrid 33A7A1HYB1 where the image noise product is terminated within a resistive load. The output port of the hybrid is matched for interface with the IF amplifier 33AR1. L1-A, C1 and L1-B, C2 (low-pass filters) filter the two mixer outputs. Image rejection is achieved within R1.

2–69. Frequency Multiplier Group 33A2

a. General. The frequency multiplier group provides the final local oscillator frequency, 30 MHz higher than the received RF signal. The frequency multiplier group consists of three subassemblies, frequency multiplier 33A2A2, frequency multiplier 33A2A1 and bandpass filter 33A2FL1. The 33A2A2 doubles the incoming frequency from the receiver fixed head. The 33A2A1 is a variable frequency multiplier, and produces the continuously variable, final local oscillator frequency in the range of 425 to 735 MHz by doubling the input frequencies from 212.5 to 289.75 MHz and tripling the input frequencies from 193.333 to 245.0 MHz. The change in multiplication factor is accomplished by changing the input frequency to the point where the output tuned circuit selects the required harmonics. The second harmonic is selected over the required portion of the band and then the input frequency is stepped down to the point where the tuned circuit selects the third harmonic. Bandpass filter 33A2FL1 is a tunable filer which attenuates all unwanted sub-multiples of the local oscillator frequency applied to the frequency mixer stage.

b. Block Diagram Analysis (fig. 2–67). The RF input in the range of 95 to 145 MHz, at a level of +15 dbm, is fed into the low pass filter section of frequency multiplier 33A2A2 where the unwanted signals are removed. The filtered signal is then fed to the full-wave diode frequency doubler and then amplified in the 3-stage wideband RF amplifier. The output signal in the frequency range of 190 to 290 MHz is filtered again in the low pass filter at the output of 33A2A2. The output of frequency multipler 33A2A2, at a level of +16 dbm ±1.5 dbm, is fed to the multiplier section of the variable multiplier 33A2A1. The multiplier section generates a signal rich in harmonics, which is then amplified and filtered in two separate stages. The frequency selective circuits are ganged to the front panel RCVR SIG and MULT PEAK controls. The tuned circuits select the second or third harmonics, thereby producing a variable frequency 30 MHz higher than the received frequency. The output of 33A2A1 is fed to tunable bandpass filter 33A2FL1 which attenuates the unwanted submultiples of the local oscillator frequency. The bandpass filter is also ganged to the front panel RCVR SIG and MULT PEAK controls (fig. 2–65) and is tuned, with the frequency selective circuits, 30 MHz above the frequency of the received signal.

2–70. Frequency Multiplier 33A2A2 or 34A2A2

a. General. Frequency multiplier 33A2A2 or 34A2A2 is a fixed multiplier which doubles the RF output of amplifier-frequency multiplier

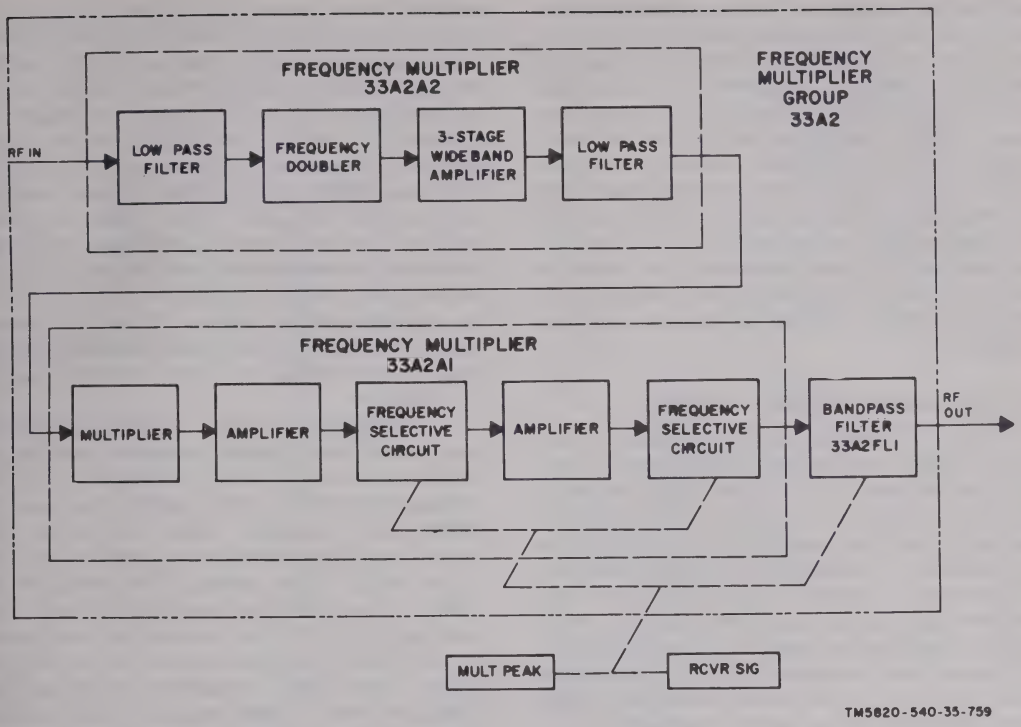


Figure 2–67. Frequency multiplier group 33A2, block diagram.

1RE1A5, part of the receiver fixed head. The unit consists of three subassemblies, low pass filter FL1, frequency multiplier assembly A1 and low pass filter assembly FL2. The input to the unit is in the frequency range of 95 to 145 MHz, at a level of +15 dbm ±3 db. The output of the unit is in the frequency range of 190 to 290 MHz, at a level of +17 dbm ±2.0 db.

b. Detailed Circuit Analysis (fig. 7–10). The output of 1RE1A5 is fed through pin A1 of P1 to low pass filter FL1. Low pass filter FL1 is a seven-element, M-derived filter which provides a 30-db attenuation at 190 MHz (2nd harmonic of the lowest input frequency) and 3 db at 150 MHz. The M-derived filter provides a sharp cutoff, necessary because the operating range is 95 to 145 MHz and the second harmonic of 95 MHz is 190 MHz. The insertion loss of the filter is 0.75 db over the operating frequency range. The filter consists of L1, L2, L3, L4, C2, C3 and C4; variable capacitors C1 and C5 are provided for alignment. The filtered RF signal is fed through J1 of frequency multiplier assembly A1 to the frequency doubler, T1 and CR1. Transformer T1 is a three-wire ferrite transformer with a balanced ouptut. The output of T1 is balanced by variable capacitor C1. Balancing the output of T1 reduces the fundamental and third harmonics of the doubler output. The output of transformer T1 drives the full-wave doubler, consisting of the pair of matched hot carrier diodes CR1A and CR1B in CR1. Shunt tuned circuit L1 and C2 along with R1 provides a return path to circulate harmonics. The nominal loss of the doubler is 10 db. The doubled signal is coupled through C3 and series tuned equalizer circuit, C4, L2 and R2, to the base of amplifier Q1. The output of Q1 is fed to amplifier Q2 and then to Q3, through respective series-tuned equalizer circuits L4, C6, R8 and L5, C7, R11. The interstage equalizer networks ensure optimum gain of the three-stage amplifier over the frequency range. The nominal gain of the amplifier is 16 db. The first two amplifier stages, Q1 and Q2, are class "A" operated to obtain maximum gain. To obtain constant output power over the frequency range, the third stage Q3 is driven

into class "C" operation. Voltage dividers R3–R4, R5–R7 and R9–R12 provide the appropriate dc bias for Q1, Q2 and Q3 respectively. The output of frequency multiplier assembly A1, is coupled through C18 to J2 and fed to P1 of low pass filter assembly FL2. The RF signal, in the frequency range of 195 to 290 MHz, at a level of 17.75 db ±2.0 db, is fed through low pass filter assembly FL2 which consists of L1, L2, L3, C1, C3, C5, and C7. Four variable capacitors C2, C4, C6 and C8 are provided for filter alignment. The insertion loss of the filter is 0.75 db at the operating frequency and 13 db minimum above the operating frequency.

2–71. Frequency Multiplier 33A2A1

a. General. Frequency multiplier 33A2A1 provides the final local oscillator frequency by doubling the frequency of the signal from frequency multiplier 33A2A2 over a portion of the band and tripling it over the remainder of the band. The unit consists of a transistor harmonic generator and a two-stage amplifier. The two stages of the amplifier are coupled to tuned circuits which select the required harmonics. The change in multiplication factor is accomplished by changing the input frequency to the point where the output tuned circuit selects the required harmonic.

b. Circuit Description (fig. 7–11).

(1) *Multiplier section.* The output of the frequency multiplier 33A2A2, in the frequency range of 195 to 290 MHz, at a level of +17 dbm ±2.0 db, is applied to input connector J1. The signal from J1 is applied to the base of harmonic generator Q1 through the input matching network which consists of tuned circuit L1, R1, Z1, C1, R2, and 33A2A1C1 (C1 is mounted outside circuit board 33A2A1A1). L1 and 33A2A1C1 are adjusted for a low Q. Q1 is the harmonic generator, operated in class C. Zener diode CR1, connected across the dc supply line for Q1, limits the power dissipation of the transistor by limiting the collector voltage to 5.6 volts. The output of the multiplier, a signal rich in harmonics, is coupled to the amplifier section through broadband matching network L2, R3, and C2. L2 attenuates the fundamental frequency to enhance the harmonic production. R3 provides a load at any frequency to keep Q1 stable and it also reduces feedback of high frequency harmonics through the collector-base capacitance. C2 couples the desired harmonics to amplifier Q2.

(2) *Amplifier section.* The output of multiplier Q1 is coupled to the base of Q2. R4, R5 controls the dc bias of Q2. C3 and R6 in the dc feedback circuit provide bias stability for a more linear response. The output of Q2 is coupled through output matching network L3, R7, C5 to resonant circuit Z2, C2. Both amplifier stages are operated in class "A," and contain similar input and output coupling networks, except that the first stage works on a smaller collector current due to lower RF level. The tunable resonant circuits, in the output of the amplifiers, reject the unwanted frequencies and select the required frequencies. Multileaf air capacitors C2 and C3, in the resonant circuit cavities Z2 and Z3 respectively, are ganged to the tuning mechanism of the local oscillator filter and receive tunable filter of the duplexer.

(3) *Tuning mechanism.* The direct transmission method used insures consistent tracking between frequency multiplier 33A2A1 and filter bandpass 33A2FL1. The output frequency is continuously variable, using the RCVR SIG control and idler trimming arrangement actuated by the MULT PEAK control. The tuning mechanisms of variable amplifier 33A2A1 and filter bandpass 33A2FL1 are ganged to each other through two bevel gears, mounted on different shafts, driving their respective capacitors. The multiplier shaft is then coupled to the duplexer receive filter mechanism through a reduction gear box. The RCVR SIG control actuates the four-cavity duplexer filter and adjusts bandpass filter assembly 33A2FL1 and multiplier assembly 33A2A1 to a point near the required tuning point; the MULT PEAK control then tunes the bandpass filter and multiplier assembly to their required tuning point.

2–72. Bandpass Filter 33A2FL1

The output of variable frequency multiplier is applied to the input connector J1 of bandpass filter 33A2FL1 (fig. 7–6). From J1 the signal is fed to resonator Z2 through input matching network L1, Z1. The filter consists of two fixed length capacitively loaded coaxial resonators Z2 and Z6. The loading capacitors C1 and C5 are variable and ganged to the tuning mechanism of variable multiplier 33A2A1. The input and output loading networks are similar and consist of an inductor and a parallel capacitor. The signal is coupled from Z2 to Z6 through a tee-network consisting of inductors L2, L3 and L4. Z3, Z4 and Z5 are parallel self capacitances of the coils.

2–73. Intermediate Frequency Amplifier 33AR1 or 34AR1

a. General. The intermediate frequency ampli-

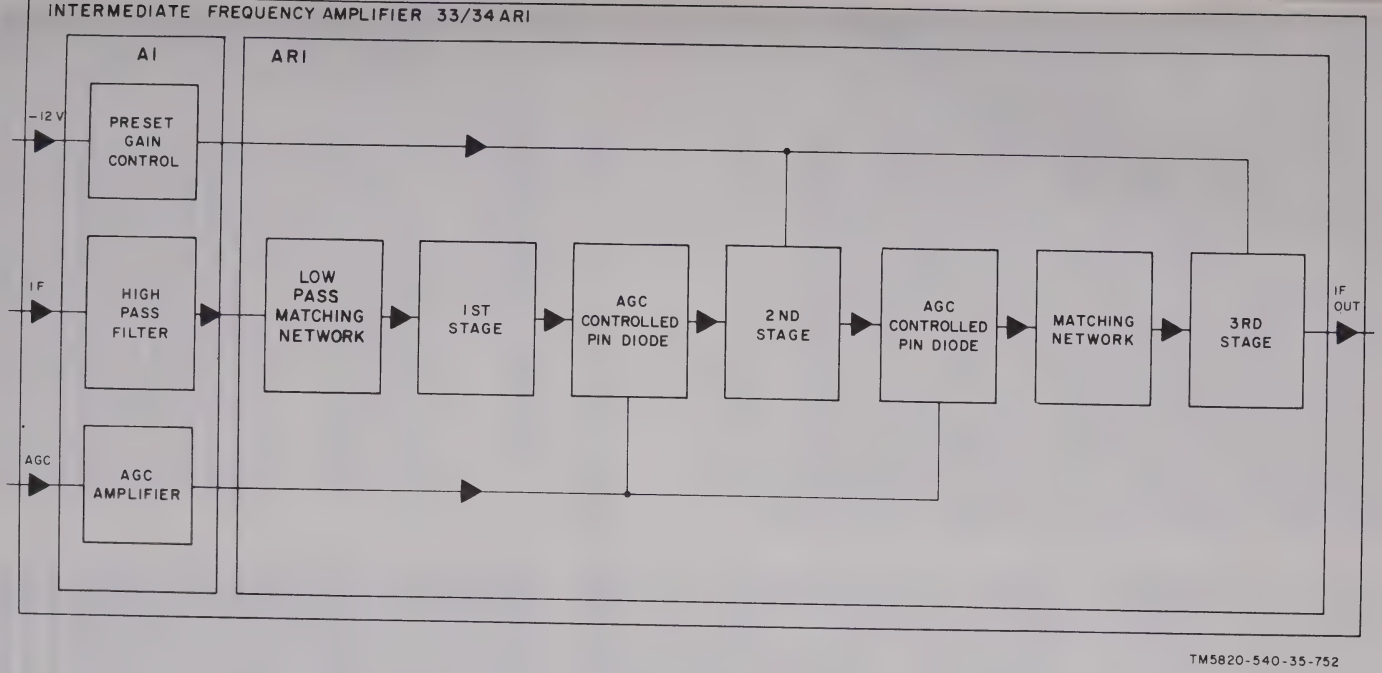


Figure 2–68. Intermediate frequency amplifier 33AR1 or 34AR1, block diagram.

fier 33AR1 or 34AR1 is part of an IF system consisting of intermediate frequency amplifier 33AR1 or 34AR1, bandpass filter 1RE1FL1 and intermediate frequency amplifier 1RE1AR2. (The latter two are located in the receiver fixed head.) IF amplifier 33AR1 or 34AR1 is a three-stage amplifier with automatic gain control of the last two stages. The agc voltage is derived from video amplifier 1RE1AR1, located in the receiver fixed head. The overall gain of the IF amplifier is 50 db nominal and the automatic gain control provides gain adjustment down to 10 db.

b. Block Diagram Analysis (fig. 2–68). The 30-MHz IF signal from frequency mixer stage 33A7 or 34A7, at a level ranging from —35 to —75 dbm (depending upon the received signal strength), is fed into the high-pass filter, part of amplifier-filter 33AR1A1 or 34AR1A1. The high-pass filter attenuates all signals below 30 MHz. The output of the high pass filter is fed to the first stage of the IF amplifier through a low pass matching network (part of 33/34AR1AR1). The low-pass matching network matches the output impedance of the high-pass filter to the input impedance of the first amplifier stage. The outputs of the first and second amplifer stages are controlled by agc-controlled PIN diodes. The input to these PIN diodes is current from the agc amplifier. The input to the agc amplifier is voltage from the receiver fixed head. A preset gain control provides a ±5 db adjustment of the overall gain.

c. Detailed Circuit Analysis (fig. 7–12). The 30-MHz IF signal from frequency mixer stage 33A7 or 34A7, at pin A1 of connector P1, is fed to the high-pass filter consisting of C1, C2, C3, C4, C5, L1, L2, L3 and L4 in amplifier-filter 33/34AR1A1. This filter provides 56 db attenuation at 15 MHz. The adjustable inductors L1, L2, L3 and L4 are aligned using the pole-zero method. The filtered IF signal, at connector J1 of IF amplifier 33/34AR1AR1, is fed through low pass through C4 to the base of Q1. The low pass matching network L1, L2, C1, C2 and coupled through C4 to the base of Q1. The low pass matching network matches the impedance of the high pass filter to the input impedance of Q1. L1, L2 are adjustable and are aligned by the swept vswr method. R1, RT1, R2 is the bias network for Q1 and L4, C6 and R3 forms the collector load. R3 provides isolation against the impedance variations of CR1. The amplified signal is coupled through C9 to the base of second amplifier stage Q2. R5, R7, and R4 forms the bias network for Q2. R6 is the collector load for Q2. L7 prevents CR2 from being back-biased by the potential developed across R6. The gain of this transistor stage is adjusted by potentiometer R4 mounted on 33AR1A1. The output of the second stage is coupled to the base of the third stage Q3, through input matching network R8, C14, L11. The gain of the third stage is also adjusted by gain control potentiometer R4 in 33AR1A1. The amplified output is fed to the receiver fixed head through the output matching network consisting of R9, L12 and C18. Two PIN diodes CR1 and CR2 are connected at the input of the second and the third stages. The resistance of these two PIN diodes is controlled by the agc current through Q1 in amplifier-filter 33AR1A1. The agc voltage from the video amplifier in the fixed head is fed through pin 1 of P1 through filter-network L5, C7 to the base of agc amplifier Q2. Q1 and Q2 of the amplifier are connected in a differential configuration and the input voltage variations are converted into current variations which in turn control the resistance of the PIN diodes.

2–74. Power Supply 33PS1 or 34PS1 Deleted.

2-75. Voltage Control Assembly 33A1A2 or 34A1A2

Deleted.

Section VIII. AMPLIFIER-FREQUENCY MULTIPLIER AM-4322/GRC-103(V)

2-76. Functional Block Diagram Analysis of Amplifier-Frequency Multiplier AM-4322/GRC-103(V) (fig. 2-69)

The RF output of the band III transmitter fixed head, in the range of 95 to 145 MHz at a level of 35 dbm, is fed into amplifier-frequency multiplier AM-4322/GRC-103(V) (transmitter RF head), where it is multiplied and amplified to produce the final transmitter frequency.

a. The transmitter RF head multiplication circuits provide the final multiplication required to produce the selected transmitter channel frequency. The multiplication is accomplished in frequency multiplier 38A1 which contains a frequency doubler and a variable multiplier which multiplies the second harmonic frequency by three or by four. The output harmonic frequency of the frequency multiplier is selected by two tuned cavities which are ganged to the front panel XMTR TUNE control. The frequency multiplier also produces an alc voltage which keeps the transmitter fixed head output at a preset value. The multiplied frequency is also amplified in the frequency multiplier circuit by an alc controlled amplifier. The output of frequency multiplier 38A1, in the range of 695 to 1000 MHz at a level of 23 dbm, is fed into RF amplifier 38AR1AR1.

b. The amplification of the output signal to the final output level is done in two-stage radio frequency amplifier 38AR1AR1 (driver and output amplifier), using two planar triodes type 7211 mounted in tuned-cathode, tuned-plate coaxial quarter-wave resonant cavities. The XMTR TUNE control, on the front panel, tunes the cathode and plate plungers of both stages. Coupling is achieved by coupling probes. Forced air is used for cooling the tubes. Concentric cavity design gives adequate exposure of the plate radiators to the airstream.

c. Radio frequency amplifier 38AR1AR1 amplifies the final frequency of the transmitter to a level of approximately 30 watts. The amplifier RF signal is then fed to 3-port circulator 38AR1HY1.

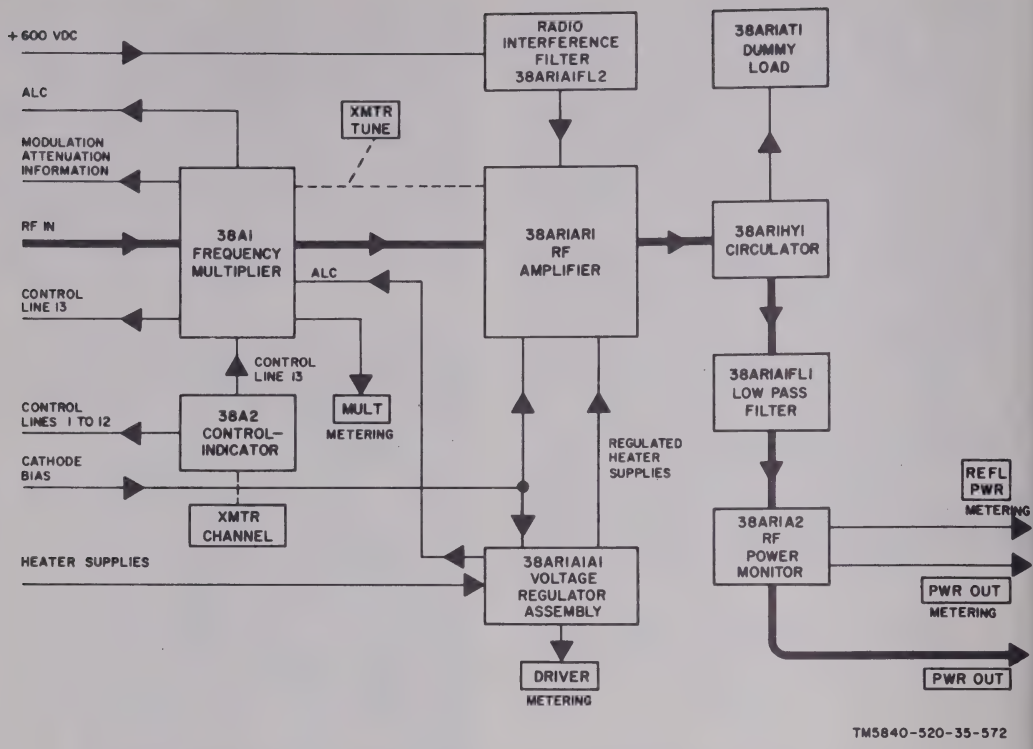


Figure 2–69. Band III transmitter RF head, block diagram.

The circulator permits the outgoing signal to pass from port 1 to port 2, but prevents any reflected signal from reaching port 1. The reflected signal is bypassed through the third port to a dummy load. After rejection of unwanted harmonics in low pass filter 38AR1A1FL1, the output signal is fed through RF power monitor 38AR1A2 and PWR OUT connector to amplifier-converter AM–4318/GRC–103(V) (band III receiver RF head) and through a duplexer, to the antenna system. A sample of output power and reflected power is rectified in the power monitor and taken out as PWR OUT and REFL PWR metering signals.

d. Control-indicator 38A2 (channel selector) is an electromechanical device operating in conjunction with electrical frequency synthesizer and amplifier monitor in the transmitter fixed head. The channel selector provides 13 control lines. Control lines 1 to 12 inclusive program the frequency generating circuits in the electrical frequency synthesizer. Control line 13 is fed through the amplifier frequency multiplier to the amplifier monitor in the transmitter fixed head to control variable attenuators in amplifier-monitor 5TR1A5. Voltage regulator assembly 38AR1A1A1 supplies the regulated heater supply for the driver and output tubes.

e. An overall schematic diagram of the band III transmitter RF head is shown in figure 8–1 and the interconnecting diagram is shown in figure 8–2.

2–77. Frequency Multiplier 38A1

a. General. Frequency multiplier 38A1 multiplies the transmitter fixed head output signal by six to produce 695 to 839.5 MHz, or by eight to produce 840 to 1,000 MHz. The output signal, at a level of +23 dbm, is the input drive for radio frequency amplifier 38AR1. Frequency multiplier 38A1 consists of two printed wiring boards mounted in a six-compartment aluminum casting. Two casting compartments incorporate two tuned

cavities, while a doubler, a multiplier, the cavities gear drive, and an electrical connector are contained in the remaining compartments. The center conductors of the cavities are variable plungers driver by precision lead screws which are ganged to the XMTR TUNE control.

b. Block Diagram Analysis (fig. 2–70). The output of amplifier frequency multiplier 5TR1A4, in the frequency range of 104 to 140 MHz at a level of +35 dbm, is fed through the input matching network to the A1Q1 wideband doubler circuit. Parametric multiplier A1Q1 amplifies the input fundamental frequency while the collector-to-base capacitance acts as a varactor for harmonic generation. The output of the wideband doubler is fed through the output matching network to the diplexer filter which terminates the fundamental frequencies and provides a path for the second harmonics. The output of the diplexer filter is applied through the input matching network to variable frequency multiplier transistor A1Q2. The A1Q2 circuit multiplies the RF signal by three or by four. Tunable cavity A1Z1 selects the required harmonic from the output of the multiplier. The filtered output is fed to amplifier stage A1Q3, which provides up to 7-db gain for the multiplier signal. The output of the amplifier is tuned by cavity A1Z2 which is ganged to A1Z1 and the front panel XMTR TUNE control. The amplifier-frequency multiplier 38A1 contains two automatic level control (alc) circuits: the input alc which maintains a constant drive to the X2 multiplier circuit (A1Q1) and the output alc which regulates the X6 or X8 RF output, which in turn drives the radio frequency amplifier 38AR1. The transistor in the alc circuit controls the incoming RF level by controlling the dc current consumption of the two multiplier stages (X2 and X3—X4). Automatic level control of the output signal is provided by A1Q1 and A1Q4. This circuit controls the collector voltage supply to A1Q3 amplifier stage. The alc circuit is driven by a signal from the RF power amplifier 38AR1 in proportion to the RF drive signal. A portion of the output signal is fed into the metering circuit where it is rectified and used as the MULT metering signal. Control line 13 from control-indicator 38A2 is used to operate attenuator switching relay K1. The relay supplies information to the modulator in the fixed head to change its sensitivity when the multiplication factor changes from six to eight.

c. Detailed Circuit Analysis (fig. 8–3).

(1) *Frequency doubler.* The RF input from J1 is fed through an input matching network to transistor multiplier A1Q1. The input matching network contains a bandpass network and an impedance transforming network. The bandpass network consists of C4, L1, C5 and L2 and is used to isolate the input circuit from the multiplier output frequencies. The parallel resistive network R5 and R6 in series with 4:1 transformer T1, matches the input impedance of A1Q1. The fundamental frequency, from the input matching network, is coupled through dc blocking capacitor C8 to the base of A1Q1. R7 provides a small reverse bias on the base of A1Q1 for optimum efficiency. C7 cancels any inductance introduced by the transformer at midband. Collector supply for 38A1Q1 and 38A1Q2 is derived from the + 28vdc through 38A1R2. L7 and C12 resonate with the transistor output capacitance at the fundamental midband frequency. The capacitance between the base and collector of A1Q1 varies nonlinearly with the transistor collector voltage. The transistor amplifies the fundamental which drives the variable base-collector junction capacitance, producing a highly distorted output waveform. This waveform contains components of the fundamental and harmonic frequencies. The A1Q1 output is fed through output matching network C14, L8 to the diplexer filter.

(2) *Input alc circuit.* The voltage applied to the input alc transistor 38A1 A1Ql is developed across resistor 38A1R2 through which passes the current consumed by the two multiplier stages 38A1Q1 and 38A1Q2. R3, the ALC LEVEL potentiometer, is set for maximum current through 38A1R2. When the incoming RF signal is too high, the voltage at the base of alc transistor Q1 causes its collector voltage (input alc) to increase; this increase in the input alc voltage applied to the alc circuit in the amplifier-frequency multiplier 5TR1A4 will cause a decrease of the RF output. The reverse is true for a weaker incoming RF signal. Since the input RF signal is a function of the dc current consumption, the supply current once set, controlling the input RF level becomes independent of multiplier transistor efficiency or transistor parameters. C6 provides RF decoupling and R4 is the collector load.

(3) *Diplexer filter.* The diplexer filter is a power splitter providing a path to terminate the fundamental frequencies at one port and a path for the second harmonics to the third port. The diplexer is a combination low-pass—high-pass filter with seven sections. The fundamental frequencies are fed through the filter and termi-

nated in A1R1. The second harmonics, fed through the filter to the output port, are coupled through C18 to the variable frequency multiplier 38A1A2 circuit.

(4) *Variable frequency multiplier.* The output of the frequency doubler is coupled through input matching network R1, C1, C2, C3 to the base of frequency multiplier A1Q2. The output at the collector of A1Q2 is the signal rich in second or third harmonics. L1 in parallel with R10 forms an idler circuit which resonates with

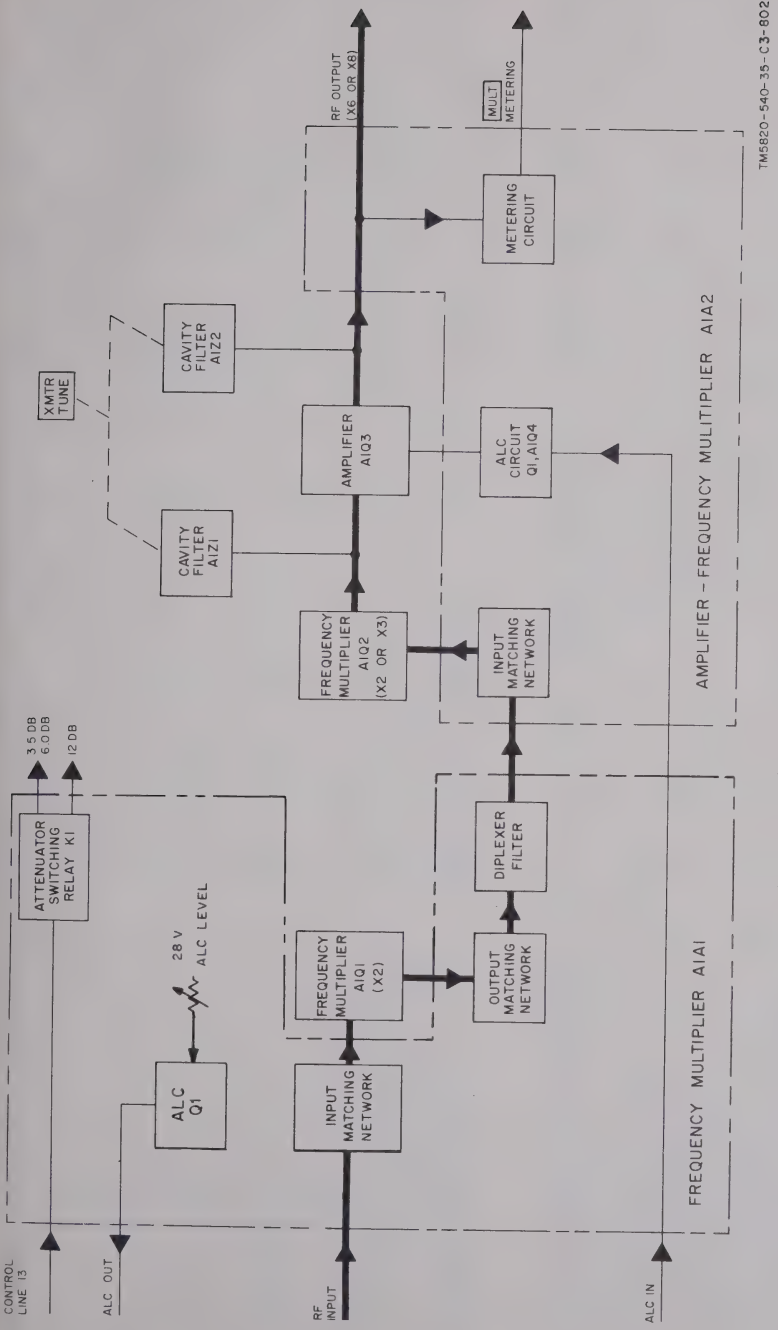


Figure 2-70. Amplifier frequency multiplier 38A1, block diagram.

the collector-to-base varactor capacitance at 250 MHz (midband of the fundamental input frequencies) to produce second harmonic frequencies. Capacitors C5 and C6 provide RF decoupling at the operating frequencies and at low frequencies. The second harmonic idler, L2, C7 and A1Q2 collector-base capacitance, provide a low impedance path to circulate the second harmonic current, thereby producing third harmonic frequencies. C4 completes the idler loop, along with the second harmonic idler components. The multiplier output is coupled through C7 to filter cavity A1Z1 through A1L1 and A1L2 to the base of amplifier A1Q3.

(5) *Cavity filter A1Z1 and A1Z2.* The output of the variable frequency multiplier is coupled through A1L1 to cavity filter A1Z1. The cavity is a quarter-wavelength tunable filter which tunes the output from the multiplier. The selected harmonics are coupled through A1L2 to the amplifier A1Q3. The value of coupling coils A1L1 and A1L2, in parallel with the coaxial line, is seected to provide a constant bandwidth over the frequency range. A1L1 and A1L2 provide an effective inductance of .0081 μh. The required capacitance to resonate this inductance is obtained from the capacitance of the plunger. Trimmer capacitors A1C1 and A1C2 resonate the fixed portion of the coaxial line. A1Z2 filter circuit, in the output of amplifier A1Q3, is identical to the A1Z1 filter circuit. A1L3 and A1L4 are the input and output coupling coils, for A1Z2, and A1C4 and A1C5 the trimmer capacitors. The bandwidth of the circuit is determined primarily by the multiplier cavity. The amplifier cavity bandwidth is wider to compensate for small tracking errors between the two cavities. Both cavities are ganged to the front panel XMTR TUNE control.

(6) *Alc controlled amplifier A1Q3.* The filtered output from cavity A1Z1 is coupled into the amplifier A1Q3 which provides approximately 7 db gain R11 slightly forward biases he base of A1Q3 to increase the gain of he amplifier stage at lower drive levels. L3, C9 and R7 form an equalizer to reduce the drive to the amplifier over the low frequency end of the times three range. L3 and C9 resonate at 950 MHz and present a high impedance to the base signal at the high frequency end of the band and a low impedance at the low frequency end. L4 and C10 filter the collector dc supply. The collector supply voltage is fed through series regulator A1Q4 to provide automatic level control. A1Q4 is controlled by Q1 which receives its drive from the power amplifier. The input alc signal is proportional to the RF drive to the cathode of the power amplifier driver tube. This signal is applied through P1 pin 8 to zener diode CR1 and the base of transistor Q1. CR1 limits the drive into Q1 to 3.3 volts, to insure that Q1 output never goes below 3 volts. Potentiometer R6 is adjusted for a minimum output level of +23 dbm from RF out connector J2, or 15 volts at the emitter of A1Q4, whichever is the least. Q1 drives the base of series regulator A1Q4 thereby varying the collector supply voltage to A1Q3 and consequently the gain of A1Q3. The amplified signal is coupled through C11 to cavity filter A1Z2 where the signal is further tuned to the required transmitter frequency. The output signal to RF amplifier 38AR1AR1, is coupled through low pass filter Z2, C14, Z3 to the output connector J2. The low-pass filter has a cutoff frequency above 1000 MHz.

(7) *Metering Circuit.* A portion of the output is coupled to a directional coupler comprising two striplines on the printed circuit board. Since the coupling energy increases with the increasing frequency, coil L5 is placed in series with the detector diode CR2 to provide a constant RF drive to the diode. RF decoupling is provided by C12. The detected RF is fed to the metering circuit in the transmitter fixed head for MULT meter indication.

(8) *Modulator sensitivity relay K1.* Relay K1 receives its actuating signal through control line 13 from the channel selector. For output frequencies of 695 to 839.5 MHz, control line 13 is open and 26v neutral is applied to the 12 db line through K1 contacts A2, A3. From 480 to 1000 MHz, line 13 is grounded and 26v neutral is supplied to the 3.5 and 6 db line through contacts A2, A1.

2-78. Radio Frequency Amplifier 38AR1AR1

a. General. Radio frequency amplifier 38AR1AR1 amplifies the final selected transmitter frequency by 23 db in two power amplifier stages. Each stage uses a type 7211 lighthouse tube mounted in a tunable resonant cavity. The cavity design uses a coaxial quarter-wave resonant cavity (fig. 2-71) for both the plate and cathode circuits. The heater connection to the amplifier tube is made through the hollow cathode lead screw inside the center conductor of the cathode grid resonator. The lead screw is of a double-start nature to enable rapid transit of the tuning plungers. Cathode feed (input signal) is taken in through the input connector which is adjacent to the gear plate. This input signal is then passed through a 50-ohm feeder coaxial cable, firmly

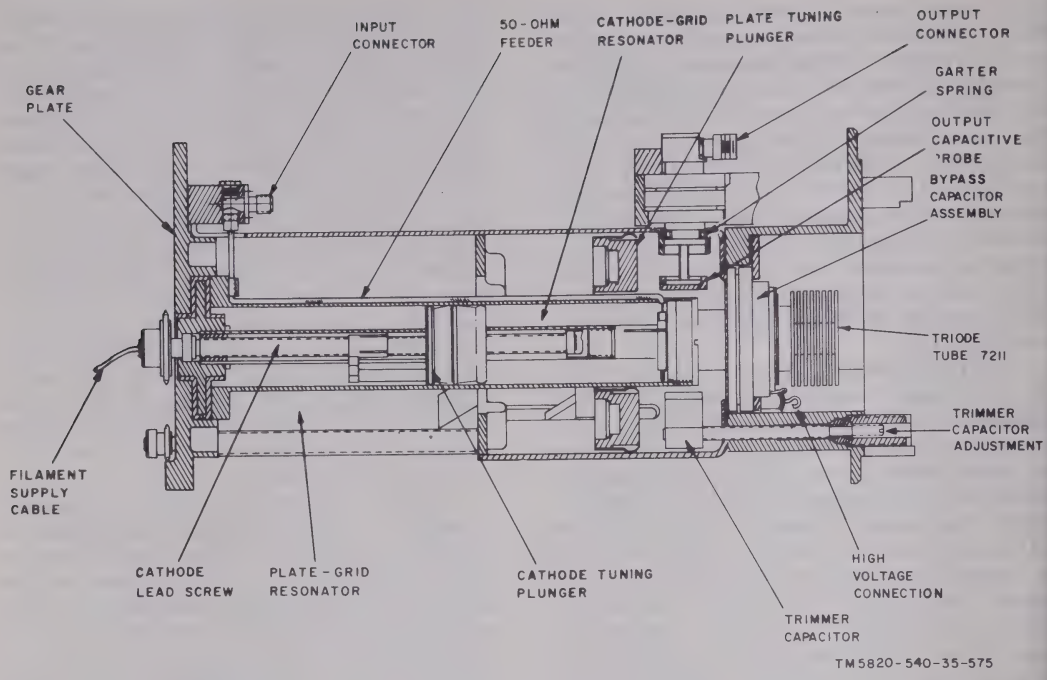
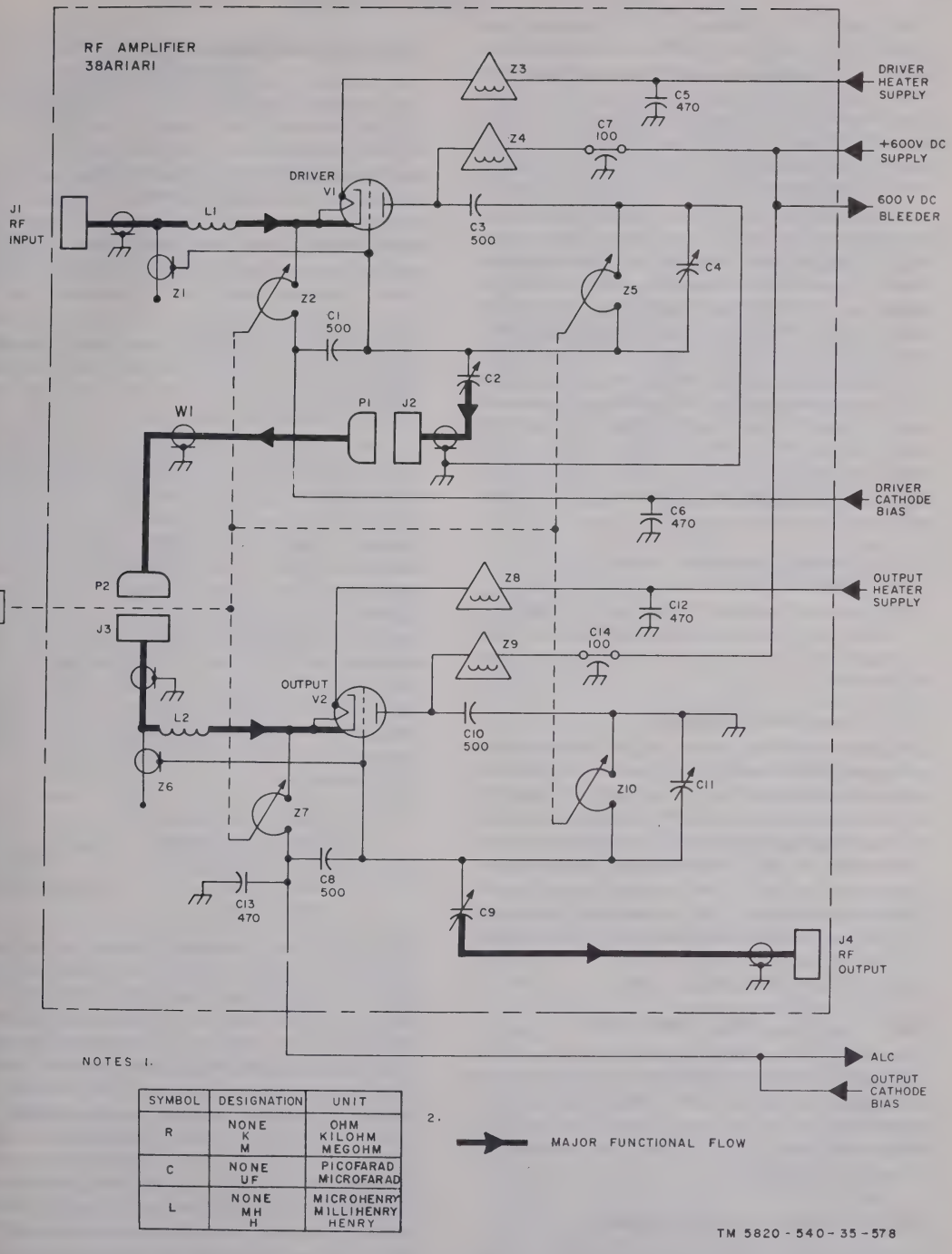


Figure 2–71. Power amplifier (band III) resonator cavity cross section.

bonded to the outside of the grid cathode resonator cavity, and fed through the cathode contact assembly to the cathode. Dc isolation is achieved within the cathode contact assembly. The plate supply is decoupled by a capacitor (bypass capacitor assembly) integral to the amplifier tube socket. The capacitor is a silvered mica disc in a potted assembly. Dc power to the tube plate is fed to the high voltage connection mounted on the plate side of the bypass capacitor assembly. Tuning the cathode and plate resonators is accomplished by adjusting mechanically coupled plungers, ganged to the XMTR TUNE control. Output coupling of the resonators is by capacitive probes located at the tube of the plate-grid resonator.

b. Detailed Circuit Analysis (fig. 2–72). The signal from amplifier frequency multiplier 38A1 is fed through connector J1 and input matching network L1, Z1 to the cathode of driver tube V1. Z1 is a section of open-circuit transmission line which forms a shunt capacitance to the grid of V1 which is at Dc gound. Z6 in the V2 circuit is similar and both provide impedance matching at the high frequency end of the frequency range. The driver V1 and output V2 circuits are identical. Z2 and Z7 are the cathode-grid resonant cavities and Z5 and Z10 are the plate-grid resonant cavities for the driver and output stages respectively. C5 and C12 are button-type standoff capacitors for the regulated heater supply to the driver and output stages. C7 and C14 are the feedthru capacitors for high voltage plate supply to the two stages. C4 is a trimmer capacitor in parallel with the plate-grid circuit and is used to compensate electron tube plate-grid capacitance spread of the driver stage. Similarly C11 is the trimmer capacitor in the output stage. C3 and C10 and C1, C8 are bypass capacitors and provide dc isolation. The input signal, at a level of 200 milliwatts, is fed to the cathode of the driver tube V1. The signal excites cathode resonator Z2 connected between cathode and grid of V1. The output signal from the plate of V1 resonates in plate-grid resonator Z5 and is coupled through coupling probe C2 to the output connector J2. Coupling probe C2 is preset during alignment. The driver tube output is fed through coaxial cable W1 to connector J3 of the output stage and then to the input matching network Z6, L2. Z6 and L2 perform the same function as Z1 and L1 in the driver



SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

Figure 2-72. RF amplifier 38AR1AR1, schematic diagram.

circuit and Z6 is similar to Z1. The output and driver stages are electrically and mechanically similar. The cathode dc voltage of the output stage is fed back through the heater voltage regulator assembly to the amplifier frequency multiplier. The output cathode bias changes are used to produce the alc voltage which controls the output of the amplifier frequency multiplier (input to power amplifier). The final amplified signal is fed through coupling probe C9 to the output connector J4. The cathode currents are regulated by a constant current source within the transmitter power supply 5TR1PS1. Plate supply for the two tubes is 630 volts dc at about 180 milliamperes and is supplied through radio frequency interference filter 38AR1A1FL2 which suppresses any 5-kHz components on the 630-volt supply. Resistor assembly 38AR1A1A2 bleeds off any residual high voltage when the unit is disconnected. Channel-frequency indicator DS1 is also ganged to the XMTR TUNE control and provides a visual indication of the selected channel.

2–79. Voltage Regulator Assembly 38AR1A1A1

Voltage regular assembly 38AR1A1A1 is identical to voltage regulator assembly 37AR1A1A1. Refer to paragraph 2–59 for general and detailed circuit descriptions.

2–80. Circulator 38AR1HY1

Circulator 38AR1HY1 is a 3-port ferrite device using permanent magnets. The RF output from power amplifier 38AR1AR1 is fed to J1 (port 1) of the circulator (fig. 8–1. The circulator permits the transmission of the outgoing signal from port 1 to port 2 (J2) but prevents any reflected signal from reaching port 1. The reflected signal at port 2 is directed to port 3 (J3) where it is terminated in electrical dummy load 38AR1AT1. The dummy load is a resistive network with a low vswr and dissipates up to 35 watts at 1 GHz.

2–81. Low-Pass Filter 38AR1A1FL1

Low-pass filter 38AR1A1FL1 is connected between circulator 38AR1HY1 and power monitor 38AR1A2. Low-pass filter 38AR1A1FL1 is a sealed high power filter with a cutoff above 1,000 MHz. It filters out any harmonics of the transmitter output RF signal.

2–82. RF Power Monitor 38AR1A2

RF power monitors 38AR1A2 and 37AR1A2 are identical. Refer to paragraph 2–61 for a functional description.

2–83. Control-Indicator 38A2 or 34A4

a. General. Control-indicator 38A2 (fig. 8–1) (transmitter channel selector) and 34A4 (receiver channel selector) are identical in function and construction and also similar to control-indicator 6A3 (fig. 2–38). Each channel selector provides 13 control lines (1 though 13) to the frequency synthesizer in transmitter and receiver respectively. To select the required synthesizer frequency, control lines 1 to 12 are switched on and off in a binary pattern with line 13 switched between channels 1279 and 1280 to change the synthesizer output frequency steps. The switching modules are operated by a set of cams and followers which reflect the various coding patterns as shown in the coding tables (fig. 8–4).

b. Description of Operation. The control-indicator consists of a set of eleven microswitches and a logic module (decoder command signals). The microswitches are operated by a set of cams to generate the binary code which presets the required stages of the programmed counter in synthesizer 5TR1A2 or 1RE1A2. The front panel channel-indicators consist of a series of numbered wheels. The indicating wheels are geared to the microswitch cams and to a front panel control knob. The transmitter channel selector display indicates the channel rather than the frequency selected. The following formulas should be used to translate a selected channel into a frequency and vice versa.

(1) Transmitter frequency $= \frac{\text{Transmitter channel}}{2} + 200$ MHz.

(2) Transmitter channel = (transmitter frequency —200) $\times$ 2.

On the receiver channel selector the coding is arranged to produce a local oscillator frequency 30 MHz higher than the channel indicated in the display. This is done to permit the indicator to refer to the received signal frequency, the actual load oscillator frequency being always 30 MHz higher to provide the correct intermediate frequency. The decoder unit is an encapsulated logic circuit designed to sense channel coding on eleven microswitch output lines. Up to number 1280 (transmitter) the logic module produces the same output as the input, input two to output two and so on. At channel 1280 the logic module switches the inputs so that input 12 appears at output 1 and so on. The logic module then produces output 12 (line 12) and control line 13.

2-84. Functional Block Diagram Analysis of Amplifier-Converter AM-4318/GRC-103(V) (fig. 8-5)

a. Amplifier-Converter AM-4318/GRC-103(V) (BAND III receiver RF head), incorporates a duplexing system which enables the radio set to use a single antenna for both transmit and receive sections, and circuits which convert the incoming receive signal into a 30-MHz intermediate frequency.

b. The receiver RF head duplexer 34A1 provides the necessary isolation and impedance matching between the transmit and receive signals. The transmit signal at the PWR OUT connector of the transmitter RF head at a level of approximately 25 watts is fed through an external coaxial cable, through the FROM XMTR connector on the front panel of the receiver RF head, to duplexer subassembly 34A1A1. In the duplexer subassembly, the transmit signal is fed to a tuned two-cavity filter (resonators). The tunable transmit filter is manually tuned to the transmit channel by the XMTR DUPL control. The ± 2-MHz bandwidth of the filter provides additional filtering of the transmit signal while presenting a high attenuation to the received frequency. The transmit signal is then directed through impedance matching network 34A1A1Z1 and RF power monitor 34A3 to the ANT. connector, and through an RF coaxial cable to the antenna system. RF power monitor 34A3 samples the forward and reflected power to and from the antenna system. These samples are rectified and the resulting dc voltages are used for XMTR DUPL and REFL PWR metering.

c. The receiving circuits of the receiver RF head accept modulated signals in the frequency range of 695 to 1000 MHz, at a level of —54 dbm to —94 dbm and convert them to a 30 MHz intermediate frequency (IF) which is then amplified and demodulated in the receiver fixed head. The signals from the antenna, applied to the ANT. connector by the lead-in cable, are fed through impedance matching network 34A1A1Z1 to a 3 MHz bandwidth tunable four-cavity filter (receiver section of duplexer subassembly). The tunable receive filter is manually tuned to the receive channel by the RCVR SIG control. The received signal is then fed through at high signal protection circuit (signal level control-monitor) wihch prevents RF signals greater than +15 dbm from getting into the receiver. Signal level control-monitor also monitors the protection level and triggers the HIGH SIGNAL ALARM circuit when the input level exceeds +15 dbm.

d. The RF signals are fed through low pass filter 34 FL1 which attenuates all harmonics of the incoming frequency. The output of the low pass filter is fed into the frequency mixer stage 34A7. The frequency mixer stage consists of two main circuits, a low-noise broadband RF amplifier and an image rejection mixer circuit. The 695 to 1000 MHz received RF signal is first amplified in a microwave integrated circuit amplifier. The second input to the frequency mixer stage is the local oscillator signal in the range of 725 to 1035 MHz from the frequency multiplier group 34A2 (e. below). The two signals are mixed in the two balanced mixers and the two resultant IF signals combined in a hybrid where the image rejection takes place. The 30 MHz IF output signal, 10 to 18 db above the level of the received RF signal is then fed to the IF amplifier 34AR1; the frequency mixer stage also contains a local oscillator signal metering circuit.

e. The input to the frequency multiplier group 34A2 is the output of amplifier-frequency multiplier 1RE1A5, in the range of 95 of 145 MHz. The frequency multiplier group 34A2 consists of three modules, frequency multiplier 34A2A2, frequency multiplier 34A2A1, and bandpass filter 34A2FL1. Frequency multiplier 34A2A2 doubles the input frequency from 1RE1A5. The resultant frequency from 34A2A2 is applied to the second module, frequency multipler 34A2A1, which triples the frequency over one portion of the band and quadruples it over the remaining portion, to produce a continuously variable output frequency 30 MHz above the frequency of the received signal. Mechanically, the frequency multiplier 34A2A1 is ganged to the RCVR SIG control which also drives bandpass filter 34A2FL1, the third module of the frequency multiplier group. The bandpass filter 34A2FL1 attenuates the unwanted submultiples of the output frequency from the frequency multipliers. The RCVR SIG control adjusts the variable frequency multiplier 34A2A1 and the bandpass filter 34A2FL1 to a point near the required tuning point, approximately 30 MHz above the frequency of the received signal. The MULT PEAK control then tunes the variable frequency multiplier and the bandpass filter to the required tuning point. The ganging of the RCVR SIG and MULT PEAK is such that the output

frequency from the frequency multiplier group 34A2 (local oscillator) is always 30 MHz above the duplexer receiver section. The local oscillator signal is then fed into the frequency mixer stage 34A7A1 where it is mixed with received RF signal to produce a 30 MHz IF signal. A portion of the local oscillator signal is detected and rectified in the frequency mixer stage 34A7A1 to provide the MULT metering voltage. The IF signal from the mixer stage is amplified in intermediate frequency amplifier 34AR1. The intermediate frequency amplifier 34AR1 is part of the IF amplification system which also includes bandpass filter 1RE1FL1 and intermediate frequency amplifier 1RE1AR2 in the receiver fixed head. Intermediate frequency amplifier 34AR1 has a nominal gain of 50 db without agc and a maximum gain of 10 db with maximum agc. Automatic gain control of two stages in each of the two IF amplifiers provides automatic adjustment of overall gain over a range of 50 db, depending on the input signal. Intermediate frequency amplifier 34AR1 is a broadband device, all shaping being done in bandpass filter 1RE1FL1.

f. Operating voltages, +12v and —12v regulated and 26v unregulated, required for the circuits in the receiver RF head, are supplied by the power supply 1RE1PS1 in the receiver fixed heads. An overall schematic diagram of the receiver RF head unit 34 is shown in figure 8–6 and an interconnecting diagram is shown in figure 8–7.

2–85. Duplexer Subassembly 34A1A1

a. General. Since Radio Set AN/GRC—103(V) operates with a single antenna, duplexer subassembly 34A1A1, part of duplexer 34A1, is necessary to provide isolation between the transmitted signal and the received signal. The duplexer subassembly, basically, consists of two coaxial cavity filters with a common port (ANT. connector); one filter provides filtering of the transmitter signal and the other filters the received signal. The duplexer subassembly also contains an impedance matching network 34A1A1Z1 which matches the transmit and receive filters to the antenna over the entire frequency range; S1 is a shorting device used during the alignment of transmit cavity Z7 and receive cavities Z2, Z3. In addition to the cavity filters and impedance matching network, the duplexer subassembly also contains the gearing and mechanical drive for the voltage control assembly 34A1A2 and frequency multiplier group 34A2. The chassis of the duplexer subassembly is the main structural member of the amplifier-converter AM–4318/GRC–103(V).

b. Detailed Circuit Analysis (fig. 8–6).

(1) *Transmitting path.* The transmitter portion of the duplexer subassembly consists of two quarter-wave resonant tuned cavities, 34A1A1Z6 and 34A1A1Z7. The cavities are connected in series through an intercavity coupling network. The coupling network provides the correct impedance transformation between adjacent resonators for realization of proper filter response. Both cavities are tuned in parallel with adjustable plungers controlled by the XMTR DUPL front panel control. The channel to which the transmitter cavities are tuned is indicated by channel-frequency indicator 34A1A1DS2 in the XMTR CHANNEL display window. The input and output of the resonators are connected through the end resonator coupling networks which transform the 50-ohm impedance of the system up to the correct level required by the resonators. The filter has a pass band of ±2 MHz and an insertion loss of 1.5 db for 90 percent of the band and 2.0 db for the remainder. The output of the filter, from the end resonator coupling network, is fed to the impedance matching network 34A1A1Z1 which matches the impedance of the transmitter to the antenna. The transmitter output is then fed through power monitor 34A3 to the antenna. Power monitor 34A3 measures the forward and reverse (reflected) power of the transmitted signal. Spark protection during tuning is afforded the cavities by spark gaps E2 and E4.

(2) *Receiving path.* The received signal from the antenna is connected through power monitor 34A3 and impedance matching network 34A1A1Z1 to the end resonator coupling network of the receiver cavity filter. The receiver portion of the duplexer subassembly consists of four quarter-wave resonant tuned cavities, 34A1A1Z2 to 34A1A1Z5. The cavities are connected in series through intercavity coupling networks. The coupling networks provide the correct impedance transformation between adjacent resonators for realization of proper filter response. All four cavities are tuned in parallel by adjustable plungers controlled by RCVR SIG front panel knob. The channel to which the receiver cavities are tuned is indicated by channel-frequency indicator 34A1A1DS1 in RCVR CHANNEL display window. The receiver filter has a pass band of ±3 MHz and an insertion loss of 2.0 db for 90% of the band and 2.5 db for the remainder of the band. The input and output of the resonators are coupled through end coupling networks which provide the correct source and terminating imped-

ances for the filter. Spark protection during tuning is afforded the cavities by spark gaps E1, E3, E5 and E6.

(3) *Coupling networks.* A coupling network between two adjacent resonators is provided to give the correct impedance transformation. The required characteristics are achieved by using a T-network of L–C circuits. These coupling networks between resonators Z2, Z3, Z4, and Z5, in the receive section, are identical except for the value of their components. A typical coupling network between resonator Z2 and Z3 consists of a series inductor L4 in parallel with variable capacitor C4, a series indicator L8 in parallel with variable capacitor C5 and a variable shunt inductor L6. Z11 in parallel with L6 is the stray capacitance existing between the coils when located in their housing. The coupling network between resonator Z6 and Z7 in the transmit section consists of series inductors L3, L7 and a variable shunt inductor L5. Z10 in parallel with L3 is the stray capacitance of L3 and similarly Z12 and Z13 are stray capacitance of L5 and L7 respectively.

(4) *End resonator coupling network.* The input and output end resonators of the receive and transmit filters are terminated in special coupling networks. These networks transform the 50 ohm impedance of the system up to the correct level required by the resonators, for realization of proper filter response. The input network in the receive filter consists of an inductor L2 in parallel with variable capacitor C1. A similar network at the output consists of inductor L16 and parallel variable capacitor C14. The input and output networks in the transmit section are similar, the inductors are fixed but the capacitance of these fixed inductors can be varied by a movable shield.

(5) *Impedance matching network 34A1A1Z1.* This unit provides a common junction for the transmit and receive filters. The network consists of a tee-juncton, one arm is a 50 ohm transmission line which terminates at the duplexer connector J1, and the other two arms of the tee are identical 100 ohm transmission lines. The two 100-ohm arms are connected in series with their respective filter at the resonator coupling network coil. The electrical length of these two arms changes with the on-tune and off-tune frequencies and thereby maintains the proper match between transmit and receive filters to the antenna over the entire frequency range of 695 to 1000 MHz.

(6) *Tuning mechanism.* The tuning of duplexer subassembly 34A1A1, variable frequency multiplier 34A2A1; and voltage control assembly 34A1A2 is accomplished through two main shafts mounted on the duplexer chassis. One shaft tunes the transmitter section of the duplexer subassembly and the other shaft tunes the receiver section of the duplexer subassembly, the frequency multiplier and the voltage control assembly. The transmitter section drive shaft, connected to the XMTR DUPL control through reduction gears (fig. 2–64), carries three bevel gears. Two bevel gears drive the two individual center conductor drive screws of the resonant cavities, and the third gear drives the XMTR CHANNEL indicator. Similarly, the receiver drive shaft, connected to the RCVR SIG control through reduction gears (fig. 2–73), carries five bevel gears. Four bevel gears drive the four individual center conductor drive screws of the receiver resonant cavities. The fifth gear drives the RCVR CHANNEL indicator. Also carried on the receiver section drive shaft are two reduction spur gears. One gear drives speed decreaser gear assembly 34A1MP1. The speed decreaser gear assembly provides tracking between the receiver duplexer cavities and the frequency multiplier and at the same time permits a small adjustment of the frequency multiplier, relative to the receiver duplexer, using the MULT PEAK control. This unit consists of a precision aluminum casting which incorporates a speed reduction of 40 to 1 through a worm and plastic worm gear. The clutch and stop device, mounted on the unit's main shaft, provides continuous coupling between the duplexer subassembly and the frequency multiplier during tuning by the RCVR SIG control; it also permits a slippage during two and one-quarter turns of the MULT PEAK control. The stop device is made of three stop washers and prevents failure of the clutch. The second spur gear on the receiver drive shaft provides a coupling to voltage control assembly 34A1A2. The voltage control assembly provides the tuning voltage for a varactor filter in frequency mixer stage 34A7.

2–86. RF Power Monitor 34A3

RF power monitor 34A3 is identical to RF power monitor 33A3. Refer to paragraph 2–65 for a functional description.

2–87. Signal Level Control-Monitor 34A5

Signal level control-monitor 34A5 is identical to signal level control-monitor 33A5. Refer to paragraph 2–66 for a functional description.

2–88. Low-Pass Filter 34FL1

Low-pass filter 34FL1 is a sealed unit connected between signal level control 34A5 and frequency

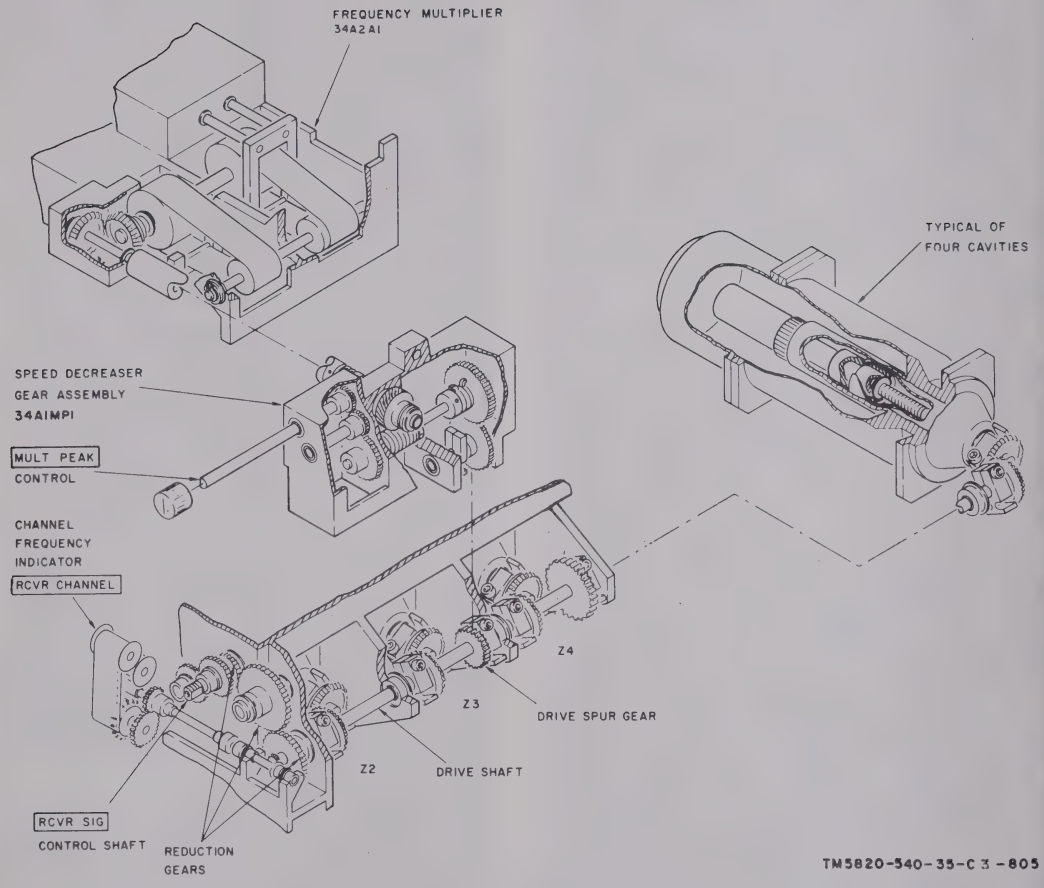


Figure 2-73. Duplexer subassembly 34A1A1, receiver section tuning mechanism.

mixer stage 34A7. It is used to suppress the harmonics of the incoming frequencies and provides a minimum of 35 db rejection at all frequencies above 2085 MHz (3 times the lowest fundamental). The vswr at either port does not exceed 1.31:1 and the power handling capacity is 25 dbm continuous.

2-89. Frequency Mixer Stage 34A7

a. General. The frequency mixer stage consists of the following four separate integrated circuit subassemblies, soldered to a printed circuit board 34A7A1: RF Amplifier 34A7A1AR1, I/C monitor-power 34A7A1A1, two balanced mixers 34A7A1A2 and 34A7A1A3, and a 3-db coupler quadrature hybrid 34A7A1HYB1 (IF). The construction of frequency mixer stage 34A7 is identical to that of frequency mixer stage 33A7 (para 2-68). The received RF signal in the range of 695 to 1000 MHz from the low pass filter 34FL1, and the local oscillator signal between 725 and 1035 MHz from the bandpass filter 34A2FL1 are mixed in the two balanced mixers; the resultant 30 MHz IF outputs are then quadrature coupled and fed to the IF amplifier 34AR1. Conversion gain of the frequency mixer stage 34A7 is between 10 and 18 db, while the noise figure is below 4.5 db.

b. Circuit Description (fig. 8-8). The RF input at 34A7J1 is applied directly to pin 1 of the RF amplifier 34A7A1AR1. The two-stage, low-noise, broadband amplifier is a microwave integrated circuit, using high gain, low-noise microwave transistors in their coplanar stripline package; fabrication of the RF amplifier circuits on an alumina substrate using thin film technology, provides a good control of assembly parasitics. The gain of the RF amplifier is 19±2 db with a noise figure 2.8 db. +12v dc and −12V dc operating voltages are applied to pins 3 and 2 of the RF amplifier, FL1 and FL2 provide RF filtering of the dc lines.

(1) The integrated circuit monitor-power 34A7A1A1 combines the functions of a 3 db coupler, an in-phase power divider and a power monitor. The RF signal at pin 4 of the RF amplifier is applied through pin 1 of monitor-power to the 3-db coupler assembly (RF quadrature hybrid) (fig. 2-73). The two RF outputs in quadrature phase are applied through pins 7 and 2 (fig. 8-8) to balance mixers 34A7A1A2 and 34A7A1A3 respectively

(2) The local oscillator signal is applied through pin 4 of monitor-power to an in-phase hybrid power divider; the two resultant local oscillator outputs are then applied in-phase through pins 3 and 6 to the two balanced mixers. The RF voltage of the incoming local oscillator signal is detected and the dc voltage is made available through pin 5 to output connector P1 pin 4 for MULT metering. Like the RF amplifier 34A7A1AR1, the monitor-power is a microwave integrated circuit realized by using thin film technology on alumina substrate.

(3) The two balanced mixer stages provide products ±30 MHz around the local oscillator frequency. The two mixers are identical, only the input pin numbers are different. The balanced configuration of the mixers provides optimum spurious performance.

(4) The two IF signals are then quadrature coupled within the 3-db coupler quadrature hybrid 34A7A1HYB1 where the image noise product is terminated within a resistive load. The output port of the hybrid is matched for interface with the IF Amplifier 34AR1. L1-A, C1 and L1-B, C2 (low pass filters) filter the two mixer outputs. Image rejection is achieved within R1.

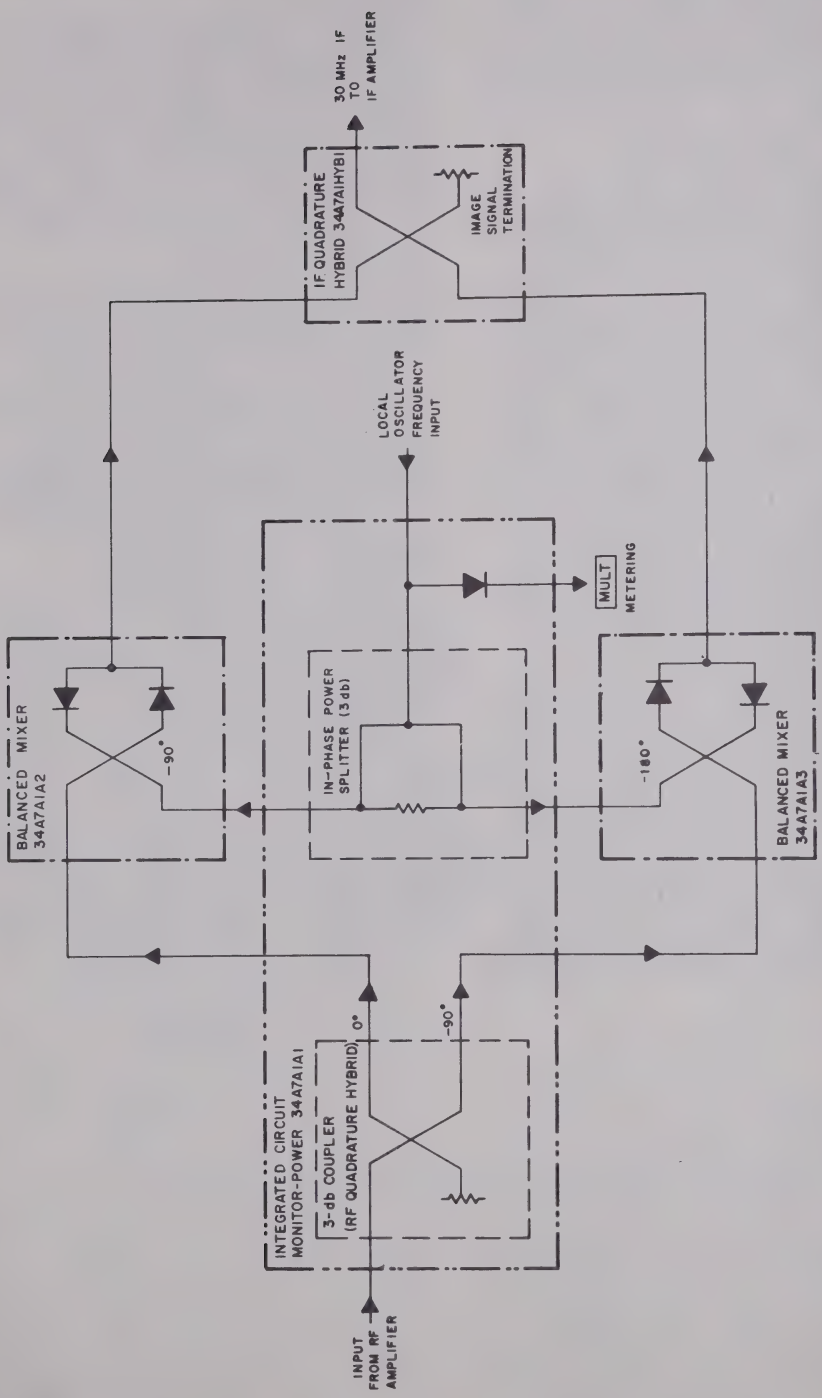


Figure 2–74. Image rejection mixer circuit, simplified functional diagram.

2-90. Frequency Multiplier Group 34A2 (fig. 2-75)

a. General. Frequency multiplier group 34A2 provides the final local oscillator frequency to the mixer, 30 MHz higher than the received RF signal. The frequency multiplier group consists of three subassemblies; frequency multiplier 34A2A2, frequency multiplier 34A2A1, and bandpass filter 34A2FL1. The 34A2A2 doubles the incoming frequency from the receiver fixed head. The 34A2A1 is a variable frequency multiplier, and produces the final local oscillator frequency in the range of 725 to 1,030 MHz, by multiplying a portion of the input frequencies by three to produce 725.0 to 839.5 MHz, and multiplying the other portion of the input frequencies by four to produce 840.0 to 1,030 MHz. The change in multiplication factor is accomplished by changing the input frequency to the point where the output tuned circuit selects the required harmonics. The third harmonic is selected over the required portion of the band and then the input frequency is stepped down to the point where the tuned circuit selects the fourth harmonic. Bandpass filter 34A2FL1 is a tunable filter which attenuates all unwanted submultiples of the local oscillator frequency applied to the frequency mixer stage.

b. Block Diagram Analysis (fig. 2-75). The RF input in the range of 95 to 145 MHz, at a level of +15 dbm, is fed into the low pass filter section of frequency multiplier 34A2A2 where the unwanted signals are removed. The filtered signal is then fed to the full-wave diode frequency doubler and then amplified in the 3-stage wideband RF amplifier. The output signal in the frequency range of 190 to 290 MHz is filtered again in the low pass filter at the output of 34A2A2. The output of the frequency multiplier 34A2A2 in the frequency range of 190 to 290 MHz, at a level of +16 dbm ±1.5 dbm, is fed to the multiplier section of the variable multiplier 34A2A1. The multiplier section generates a signal rich in harmonics, which is then amplified and filtered in two separate stages. The frequency selective circuits are ganged to the front panel RCVR SIG and MULT PEAK controls. The tuned circuits select the third or fourth harmonics, thereby producing a variable frequency 30 MHz higher than the received frequency. The output of 34A2A1 is fed to tunable bandpass filter 34A2FL1 which attenuates the unwanted submultiples of the local oscillator frequency. The bandpass filter is also ganged to the front panel RCVR SIG and MULT PEAK controls (fig. 2-73) and is tuned, with the frequency selective circuits, 30 MHz above the frequency of the received signal.

2-91. Frequency Multiplier 34A2A2

Frequency multipliers 33A2A2 and 34A2A2 are identical. Refer to paragraph 2-70 for general and detailed circuit analysis descriptions.

2-92. Frequency Multiplier 34A2A1

a. General. The frequency multiplier 34A2A1 is part of the local oscillator chain and provides the final local oscillator frequency to the frequency mixer stage. It provides times-three (725.00 to 839.5 MHz) or times-four (840.00 to 1030.00 MHz) multiplication of the input frequency at an output level of +12 dbm. The input to the unit is the output of frequency multiplier 34A2A2. The output of the unit is fed to bandpass filter 34A2FL1 before being applied to frequency mixer stage 34A7. The 34A2A1 unit consists of one printed wiring board and a casting which contains two tunable cavities. The tuning plungers of the cavities are coupled mechanically through a stainless steel band to speed decreaser gear assembly 34A1MP1 (fig. 2-73). The unit is tuned by the RCVR SIG and MULT PEAK controls through 34A1MP1.

b. Detailed Circuit Analysis (fig. 8-9).

(1) *Multiplier section.* The output of the frequency multiplier 34A2A2, in the frequency range of 195 to 290 MHz at a level of +17 dbm ±2.0 db, is applied to 34A2A1 input connector J1. The signal from J1 is applied to a low pass filter consisting of R8, R9, L2, L3 and C9. The low-pass filter reduces the input power to approximately +14 dbm, the optimum input level for fourth harmonic frequency generation by transistor multi-

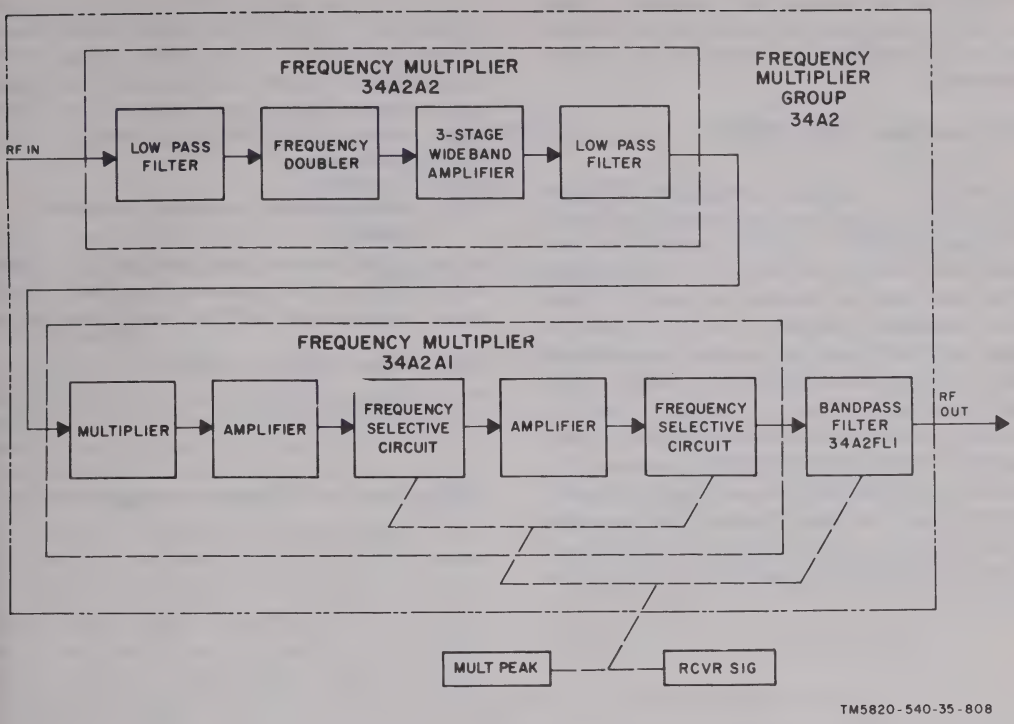


Figure 2-75. Frequency multiplier group 34A2, block diagram.

plier Q1. The low-pass filter also provides input matching to the transistor. The output of the low pass filter is coupled through C10 to the base of multiplier transistor Q1. C11 is a bias feedthrough capacitor. R10 sets the bias level so that multiplier transistor Q1 operates in class C. Q1 produces a signal rich in third and fourth harmonics which is fed through resonator Z5 to a two stage amplifier Q2, Q3. Z5 and Z8, at the output of the harmonic generator Q1 and amplifier Q3 respectively, are tuned to select the required harmonics. Both resonators are ganged to the front panel RCVR SIG control. CR1 defines the voltage across Q1 so that the class C output current peaks applied to Z5 are of constant amplitude. Z2 is an inductive distributed impedance tuned by shorting strap E4. Z2 is a stripline which tunes the input reactance of Z5. Z4 and Z6 are the inductive impedance of Z5. At Z5 and Z8, cavity adjustment capacitors C1 and C3 respectively are the middle frequency adjustment screws and C2 and C4 are the high frequency adjustment screws. R19 is the collector load resistance for Q1 and provides stability of in-band frequencies. C13 is the Q1 emitter decoupling capacitor.

(2) *Amplifier section.* The output of the frequency multiplier transistor tuned to the received frequency in resonator Z5, is coupled through C14 and input matching network C15, Z4, Z5, R11, R12 to the base of amplifier Q2. R11 and shunt resistor R12 provide stability at the input and similarly, R14 and shunt resistor R13 provide stability at the output. The amplified signal is coupled from the collector of Q2 through equalizer C18, Z6, R14 to a bandpass filter network. The bandpass filter attenuates the fundamental frequencies. The input and output matching networks for the second amplifier stage Q3 are similar to the first stage. Both stages are operated in class A with an overall nominal gain of 12 db. R2, R3 and R4, the voltage divider, provide proper bias for the operation of Q2 in class A. Similarly, R5, R6 and R7 provide proper bias for Q3. CR2

and CR3 provide reverse bias breakdown protection. The output of the amplifier is coupled through C27 and tuned resonator Z8 to the output connector J2.

2-93. Bandpass Filter 34A2FL1 (fig. 8-6)

The output of variable frequency multiplier 34A2A1 is fed to the input connector P1 of bandpass filter 34A2FL1. The filter consists of two quarterwave coaxial line cavities Z1 and Z2. The cavities are tuned by varying the length of their center conductor plunger. The RF signal is coupled to and from the cavities by inductive loops. The loops are adjusted by a setscrew. The coupling between the two cavities is by fixed slot coupling. The two cavities are ganged to the front panel RCVR SIG and MULT PEAK controls. The bandpass filter attenuates the unwanted submultiples of the local oscillator frequency to be applied to the frequency mixer stage. The cavities are located in an aluminum casting with the cavities tuning drive mechanism forming an integral part of the unit. A drive band of stainless steel fixed to a roller is coupled to the cavity plungers. The tuning drive rollers of frequency multiplier 34A2A1 and bandpass filter 34A2FL1 (fig. 2-73), use a common shaft which is actuated by the front panel controls.

2-94. Intermediate Frequency Amplifier 34AR1

Intermediate frequency amplifier 34AR1 is identicial to inermediate frequency amplifier 33AR1. Refer to paragraph 2-73 for circuit descriptions.

2-95. Power Supply 34PS1

Deleted.

2-96. Voltage Control Assembly 34A1A2

Deleted.

CHAPTER 3

DIRECT SUPPORT MAINTENANCE

Section I. INTRODUCTION

3–1. General

This chapter covers direct support maintenance for Radio Set AN/GRC–103(V)1. It lists the tools and test equipment needed to completely troubleshoot the radio set, trace faults to defective modules, and replace defective modules. Removal and replacement procedures for modules not replaced at the organizational level (TM 11–5820–540–12) are also included in this chapter. The troubleshooting and fault location techniques in this chapter supplement the operational check, loop test procedure, and troubleshooting charts of TM 11–5820–540–12. A loop test procedure that permits the radio set to be checked when associated multiplex equipment is not available is provided in paragraph 3–4.

3–2. Test Equipment Required

In addition to Converter, Frequency, Electronic CV–2500/GRC (loop test set), Dummy Load, Electrical DA–437/GRC–103(V) (dummy load), and cables which are normally supplied with the radio set, the following test equipment, cables, and connectors are required for troubleshooting Radio Set AN/GRC–103(V)1.

a. Test Equipment.

Equipment	Common name	Qty
Wattmeter, AN/URM-98	Power meter	1
Test Set, Radio Frequency Power AN/URM-120	Wattmeter	1
Generator, Signal AN/USM-44A	Signal generator	1
Counter, Electronic, Digital Readout AN/USM-207	Counter	1
Multimeter TS-352B/U	Multimeter	1
Generator, Signal AN/USM-205	Wide range oscillator	1
Voltmeter, Electronic, ME-30A/U	VTVM	1
Meter, Modulation ME-57/U	Deviation meter	1
Oscilloscope AN/USM-140	Oscilloscope	1
Attenuator, fixed, 10 db Microlab AD-10 MN	10 db attenuator	1
Attenuator, fixed, 20 db Texscan FP-50	20 db attenuator	1
Load, 600 ohms ±2%, BNC male termination CMC 335-051		1
Load, 91 ohms ±2%, BNC male termination CMC 335-052		1
Load, 51 ohms ±2%, BNC male termination CMC 335-053		1
Converter, Frequency, Electronic CV-2500/GRC	Loop test set	1
Dummy Load, Electrical DA-437/GRC-103(V)	Dummy load	1

b. Connectors.

Connector	Qty
Adapter-connector UG-636A/U (type C (male) to BNC (female))	1
Adapter-connector UG-565A/U (type N (female) to C (male))	1
Adapter-connector UG-274/U (BNC tee connector, 2 female, 1 male)	2
Adapter-connector UG-491A/u (type BNC (male) to BNC (male))	1
Adapter-connector UG-201A/U (type BNC (female) to N (male))	2
Adapter-connector UG-29B/U (type N (female) to N (female))	1
Adapter-connector UG-564A/U (type C (female) to N (male))	1

c. Cable Assemblies, Radio Frequency—General Purpose.

Manufacture No.	Connector Types	Qty
CMC 335-055	Male microminiature and female BNC	1
CMC 335-056	Male microminiature and male BNC	1
CMC 335-057	Female microminiature and male BNC	1
CMC 335-058	Female microminiature and female BNC	1
CMC 335-283	Female electrical contact, Cannon Electric type DM53740-5001 and male BNC	1
CMC 456-930	Male BNC connectors both ends	3
CMC 456-931	Male N connectors both ends	1

d. Cable Assemblies, Special Purpose, Electrical.

Manufacture No.	Connects	Qty
CMC 456-916	Radio transmitter, 5TR1 to transmitter case	1
CMC 456-917	Radio transmitter, 5TR1 to transmitter case	1
CMC 456-918	Transmitter RF head to transmitter case	1
CMC 456-919	Radio receiver 1RE1 to receiver case	1
CMC 456-920	Radio receiver 1RE1 to receiver case	4
	and/or	
	Video amplifier 1RE1AR1 to radio receiver 1RE1	
	and/or	
	Pulse form restorer 1RE1A3 to radio receiver 1RE1	
	and/or	
	Amplifier-monitor 5TR1A5 to radio transmitter 5TR1.	
CMC 456-921	Receiver RF head to receiver case	1
CMC 456-922	Power supply 1RE1PS1 to radio receiver 1RE1	3
	and/or	
	Control-indicator 6A3 to transmitter RF head	
	and/or	
	Control-indicator 2A2 to receiver RF head.	
CMC 456-924	Electrical frequency limiter-discriminator 1RE1A4 to video amplifier 1RE1AR1	1
CMC 456-925	Electrical frequency synthesizer 1RE1A2 to radio receiver 1RE1	2
	and/or	
	Electrical frequency synthesizer 5TR1A2 to radio transmitter 5TR1.	
CMC 456-926	Power supply 5TR1PS1 to transmitter case	1
CMC 456-927	Electrical frequency synthesizer 1RE1A2 to amplifier-frequency multiplier 1RE1A5.	2
	and/or	
	Electrical frequency synthesizer 5TR1A2 to amplifier-frequency multiplier 5TR1A4.	
CMC 456-929	Amplifier assembly 9A4 to distribution panel 9A1	2
	and/or	
	Telephone signal converter 9A3 to distribution panel 9A1	
CMC 456-951	Alarm control 5TR1A3 to radio transmitter 5TR1	1
CMC 217-800-000-000	If amplifier 1RE1AR2 to electrical frequency limiter-discriminator 1RE1A4	1

e. Special Tools.

Tool	Federal stock number	Qty
Wrench socket 1/2-in. drive, 7/8-in. head	5120-243-7342	1
Handle, 9-in.	5120-230-6385	1

Section II. TROUBLESHOOTING

3–3. General

This section contains the systematic troubleshooting procedure required to sectionalize a fault in the radio set and to trace the fault to the defective module or part. Front panel indications may help in locating faults without the use of test equipment. Operational tests frequently indicate the general location of trouble and in many in-

stances help in determining the nature of the fault. The operational check, loop testing procedure, and the troubleshooting charts contained in TM 11–5820–540–12 are suitable starting points. The modified loop test procedure (para 3–4), troubleshooting charts (paras 3–5 through 3–40), and signal substitution procedures enable direct support personnel quickly to localize the faulty module. Replacement of one or more suspected defective modules may be a quick and effective method of repairing a radio set in emergency conditions.

3–4. Loop Test Procedure

The purpose of this procedure is to sectionalize faults in the radio set, using the loop test procedure and troubleshooting charts in chapter 6 of TM 11–5820–540–12, but using a test signal of known amplitude instead of a test signal from the associated multiplex equipment.

a. Equipment Required.

Equipment	Common name
Generator, Signal AN/USM-205	Wide range oscillator
Oscilloscope AN/USM-140	Oscilloscope
Converter, Frequency, Electronic CV-2500/GRC	Loop test set
Dummy Load, Electrical DA-437/GRC-103(V)	Dummy load
Cable Assembly, Radio Frequency CMC 456-930 (2 required).	
Connector, Adapter UG-274/U.	

b. Connections and Test Procedure.

(1) Set up the loop test as shown in figure 6–3, (TM 11–5820–540–12).

(2) Connect the output of the wide range oscillator to the VIDEO connector at the rear of the transmitter case and to the oscilloscope using two CMC 456–930 cables and the UG–274A/U.

(3) Set the frequency of the wide range oscillator to 10 kHz and adjust the amplitude of the output signal to 2 volts peak-to-peak as measured on the oscilloscope.

(4) Proceed with the loop test procedure and troubleshooting charts as described in chapter 6 of TM 11–5820–540–12, supplemented by the troubleshooting charts in paragraphs 3–5 through 3–7 in this manual.

(5) If the fault cannot be sectionalized using the loop test procedure and troubleshooting charts, proceed to isolate the fault by signal substitution or fault locating procedures described in paragraphs 3–8 through 3–40.

3–5. Transmitter Troubleshooting

CAUTION

The transmitter RF head when extended must be air-cooled during tests; a cooling fan must be pointed toward the power amplifier tubes at all times. If a cooling fan is not available the transmitter RF head *must not be operated for longer than 5-minute periods.* Another alternative is to place the transmitter RF head back into the transmitter case while troubleshooting radio transmitter 5TR1.

a. General. For effective troubleshooting of the transmitter, remove the transmitter RF head and radio transmitter 5TR1 from the transmitter case. Remove the transmitter RF head dust cover. Connect the transmitter RF head to the transmitter case using CMC 456–918 extender cable and connect radio transmitter 5TR1 to the transmitter case using CMC 456–916 and CMC 456–917 extender cables. Connect the transmitter to a 115-volt, 47-to 420-Hz source and proceed to troubleshoot the transmitter.

CAUTION

The transmitter RF head PWR OUT connector must be connected to the dummy load, during troubleshooting. Damage to the equipment will result if this is not done.

b. Transmitter Troubleshooting Chart.

Symptom	Probable cause	Checks and corrective measures
1. When AC POWER switch is set to ON/RESET, centrifugal fan does not start, AC POWER and LOW POWER lamps do not light, buzzer does not sound.	*a.* Defective power supply 5TR1PS1.	*a.* Check for 115v ac at connector J3 (5TR1PS1P1) pins 6 and 7 (para 3-8). If voltage is present, replace 5TR1PS1 (para 3-47).
	b. Defective switch 5TR1A1CB1 (fig. 3-3).	*b.* If voltage not present (*a* above), check for 115v ac at

Symptom	Probable cause	Checks and corrective measures
		switch LINE and LOAD terminals. If indications are normal make wiring continuity checks.
2. 28V and 12V metering reads negative, all other metering zero. LOW POWER and SYNC lamps light.	Short circuit	Check for short on 28v supply line.
3. 12V metering reads negative, 28V full scale, 600V high, DRIVER normal, all other metering zero. LOW POWER and SYNC lamps light.	Short circuit	Check for short on 12v supply line.
4. All metering reads zero, all lamps are inoperative, centrifugal fan operates.	Short circuit	Check for short on 26v supply line.
5. 28V normal or zero, 12V normal, DOUBLER, MULT, DRIVER and PWR OUT low, OSC high. LOW POWER and SYNC lamps light.	Open circuit	Check for open 28v supply line.
6. When AC POWER switch is set to ON/RESET centrifugal fan does not start; AC POWER, LOW POWER, and OVERHEAT lamps light; buzzer sounds.	*a.* Defective centrifugal fan 5A2B1.	*a.* Check for 140v ac at connector J5 (5A2B1P1), pins 1 and 2, in transmitter case. If voltage is present replace 5A2B1 (TM 11-5820-540-12).
	b. Defective power supply 5TR1PS1	*b.* (1) Check for 140v ac at power supply filter terminals FL5 and FL6 of 5TR1PS1 (fig. 3-2). If no voltage is present replace 5TR1PS1 (para 3-47). (2) If voltage is present at FL5 and FL6 of 5TR1PS1 but not at pins 1 and 2 of connector J5 (5A2B1P1) in the transmitter case disconnect 115v ac power source and check for continuity between these two points.
6.1 When AC POWER switch is set to ON/RESET, centrifugal fan does not start. OVERHEAT lamp is not on. Buzzer may or may not sound. All other indications normal.	a. Defective OVERHEAT lamp 5TR1A2A2DS4.	a. Replace indicator lamp 5TR1A2A2DS4.
	b. Defective pressure differential monitor 5A2A2.	b. Replace 5A2A2 (section VIII).

Symptom	Probable cause	Checks and corrective measures
7. Buzzer does not sound when an alarm lamp lights or goes out.	*a.* Defective buzzer 5TR1A1DS5 (fig. 3-3).	*a.* Check for +26v dc at buzzer terminals. If voltage is present replace the buzzer (para 3-49).
	b. Defective switch 5TR1A1S2 (fig. 3-3).	*b.* If voltage is not present at buzzer terminals disconnect 115v ac power source and check for continuity from the buzzer negative terminal to pin 5 of connector J3 (5TR1PS1P1) and from the buzzer positive terminal to pin 4 of 5TR1A1J3. If continuity is broken because of 5TR1A1S2, higher category maintenance is required.
	c. Defective alarm control 5TR1A1A2 (fig. 3-3).	*c.* If continuity is broken because of 5TR1A1A2, replace 5TR1A1A2 board (para 3-48).
8. OVERHEAT lamp does not go off within 10 seconds after AC POWER switch is set to ON/RESET.	a. Defective pressure differential monitor 5A2A2.	a. Replace 5A2A2 (section VIII).

Symptom	Probable cause	Checks and corrective measures
	b. Defective wiring	*b.* If other than zero resistance, a short may exist between 6AR1A1FL1 and ground (fig. 6-14).
9. SYNC light does not go out within 10 seconds after AC POWER switch is set to ON/RESET.	*a.* Defective synthesizer 5TR1A2	*a.* Extend the synthesizer (para 3-10) and check for 12v, 26v and 28v at J1 (X5TR1A2P2) (fig. 3-3). If normal indications are obtained replace synthesizer 5TR1A2 (para 3-45).
	b. Defective power supply 5TR1PS1	*b.* If indications in *a* above are abnormal, check 5TR1PS1 (para 3-8). If abnormal indications are obtained replace 5TR1PS1 (para 3-47).
	c. Defective wiring	*c.* If abnormal indications are obtained in *b* above check the wiring between 5TR1PS1 and J2 (X5TR1A2P2) (fig. 6-14).
10. DRIVER metering greater than 100%.	Loss of control voltage to RF power level control 6A5.	Voltage at 6A4FL1 (fig. 3-6) should be between 7.2 and 9.5 volts (para 3-16). If normal or high replace 6A5 (para 3-54). If zero, check wiring (fig. 6-14).
11. LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. PWR OUT position reads low.	*a.* Defective power monitor 6AR1A3.	*a.* Measure power at P2 (XAR1A3J1) (fig. 3-13). If normal (para 3-20), check 6AR1A3 (para 3-21).
	b. Defective low pass filter 6AR1A2FL1 (para 3-20).	*b.* If power indication at P2 (XAR1A3J1) is abnormal, (*a* above), measure the power at 6AR1A1J2 (fig. 3-6). If normal, (para 3-17) higher category of maintenance is required.
	c. Defective amplifier subassembly 6AR1A1 (para 3-18)	*c.* If abnormal indication is obtained in *b* above measure the power at 6AR1A2A4J2 (fig. 3-6) (not less than 4 watts). If normal, higher category maintenance is required.
12. LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. PWR OUT position reads low, DRIVER position reads high.	No OUTPUT CATHODE regulation	Remove radio transmitter 5TR1 and measure the resistance from pin 30 of connector J8 (X5TR1A1A1P3) (transmitter case) to ground (approximately 14 ohms). If normal, replace 5TR1PS1 (para 3-47). If abnormal check 6AR1A2A2 (para
13. LOW POWER light does go out within 60 seconds after AC POWER switch is set to ON/RESET. PWR OUT position reads low, DRIVER position reads low.	*a.* Defective OUTPUT CATHODE/ OUTPUT HEATER circuit.	*a.* Measure the power at 6AR1A2A4J2 (fig. 3-6). If normal (not less than 3.5 watts) check the voltage at TP1 and TP2 of 6AR1A2A2 (fig. 3-13). If normal (para 3-19) disconnect the transmitter rf head and measure resistance between TP1 and TP2 of 6AR1A2A2 (should be 1.5 ohm approximately).
	b. Defective filter assembly 6AR1A2A4.	*b.* If voltage at TP1 and TP2 is abnormal check the OUTPUT HEATER/OUTPUT CATHODE circuit of 5TR1PS1 (para 3-8).
	c. No DRIVER CATHODE regulation.	*c.* If 5TR1PS1 check is normal, check continuity of OUTPUT HEATER/OUTPUT CATHODE wiring between 5TR1PS1 and 5TR1A1P3

Symptom	Probable cause	Check and corrective measures (fig. 6-14).
	d. Defective DRIVER CATHODE/ DRIVER HEATER circuit.	*d.* If the power at 6AR1A2A4J2 is abnormal measure the power at P1 (6AR1A2A4J3). If normal, (not less than 3.5 watts), higher category maintenance is required.
	e. Defective amplifier sub-assembly 6AR1A1.	*e.* Remove the radio transmitter from the case and measure the resistance from pin 29 of connector J8 (X5TR1A1A1P3) to ground (36 ohms approximately). If normal replace 5TR1PS1 (para 3-47). If abnormal check 6AR1A2A2 (para 3-19). Check * 6AR1A1C5/C11 (para 4-34).
	f. Defective filter assembly 6AR1A2A4.	*f.* Measure the power at 6AR1A2A4J4 (para 3-17). If normal, check the voltage across TP3 (−) and TP4 (+) of 6AR1A2A2. It should be +5.8v ±0.5v dc (fig. 3-13). If normal, remove the transmitter rf head and measure the resistance at TP3 and TP4 of 6AR1A2A2 (1.5 ohms approximately). If voltage at TP3 and TP4 is abnormal, check the DRIVER HEATER/DRIVER CATHODE circuit of 5TR1PS1 (para 3-8). If 5TR1PS1 check is normal, check the continuity of the OUTPUT HEATER/ OUTPUT CATHODE wiring between 5TR1PS1 and transmitter RF head (fig. 6-14).
	g. Defective RF power level control 6A5.	*g.* If the DRIVER CATHODE/ DRIVER HEATER circuit is normal higher category maintenance is required.
		h. If the power at 6AR1A2A4J4 is abnormal measure the power at P2 (6AR1A2A4J1). If it is normal (+23 dbm minimum), higher category maintenance is required.
		i. If power at P2 (6AR1A2A4J1) is abnormal measure the power at 6A1J6 (+26.5dbm minimum). If normal, replace 6A5 (para 3-54).
14. At channel 180 and above or channel 179 and below LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. PWR OUT position reads low, DRIVER position reads low, and MULT position reads low.	*a.* Defective frequency multiplier assembly 6A2. *b.* Defective wiring	*a.* Check the output of 6A2 (para 3-15). *b.* Check voltages at 6W1J1 (para 3-14).
15. Same as 14 above but at all channels.	*a.* Defective wiring	*a.* Measure power at P2 (XA1J5) (fig. 3-6) 2.5 watts minimum (para 3-11). If abnormal, check for continuity from P2 (XA1J5) to pin A2 of J11 (X5TR1A4P1) (fig. 6-14).
	b. Defective amplifier-frequency multiplier 5TR1A4.	*b.* If power indication at P2 in *a* above is normal, replace 5TR1A4 (para 3-46).

Symptom	Probable cause	Checks and corrective measures
16. LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. DRIVER position reads low, MULT position reads low, DOUBLER position reads low.	*a.* Defective amplifier-frequency multiplier 5TR1A4.	*a.* Measure the power at pin A1 of J11 (X5TR1A4P1) (para 3-10). If it is normal, check 5TR1A4 (para 3-11).
	b. Defective wiring	*b.* Check for +28v at pin 1 of J11 (X5TR1A4P1). Check for ground at pin 17 of J11 (X5TR1A4P1) with the transmitter rf head connected.
17. LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. DRIVER position reads low, MULT position reads low, DOUBLER position reads low OSC position reads low.	*a.* Defective electrical frequency synthesizer 5TR1A2.	*a.* Check synthesizer 5TR1A2 (para 3-10).
	b. Defective wiring	*b.* Check inputs to 5TR1A2 at J1 (X5TR1A2P2) (fig. 6-14). pin 1 +28v dc pin 3 0v pin 2 +12v dc pin 37 +28v dc
18. SYNC alarm does not go out within 10 seconds after AC POWER switch is set to ON/RESET.	*a.* Defective synthesizer 5TR1A2	*a.* Check synthesizer 5TR1A2 (para 3-10).
	b. Defective power supply 5TR1PS1.	*b.* Check power supply 5TR1PS1 (para 3-8).
19. When AC POWER switch is set to ON/RESET, buzzer and centrifugal fan operate, LOW POWER and SYNC alarm lights come on, DRIVER metering is low, all other metering reads zero.	Defective power supply 5TR1PS1.	Check voltage regulator amplifier 5TR1PS1AR1 of power supply 5TR1PS1 (para 3-8).
20. No communication. Metering and LOW POWER and SYNC alarms may or may not indicate normal.	Synthesizer is off frequency due to—	
	a. Defective synthesizer 5TR1A2	*a.* Check synthesizer (para 3-10).
	b. Defective wiring	*b.* Check wiring from control-indicator 6A3 to the synthesizer (fig. 6-14).

*Direct Support repair and replacement authorized.

3–6. Receiver Troubleshooting

a. General. For effective troubleshooting of the receiver, remove the receiver RF head and radio receiver 1RE1 from the receiver case. Remove the receiver RF head dust cover. Connect the receiver RF head to the receiver case using CMC 456–921 extender cable. Connect the radio receiver to the receiver case using CMC 456–919 and CMC 456–920 extender cables. Connect the receiver to a 115-volt, 47-to 420-Hz source and proceed to troubleshoot the receiver.

b. Receiver Troubleshooting Chart.

Symptom	Probable cause	Checks and corrective measures
1. With AC POWER switch set to ON, there are no meter indications and no alarms.	Defective switch 1RE1A1CB1	Check for 115v ac at switch LINE and LOAD terminals (fig. 3-32). If switch is normal, make wiring continuity checks (fig. 6-29).
2. Buzzer does not sound when any alarm lamp lights or goes out.	Defective buzzer 1RE1A1DS5	Check for 26V dc at buzzer terminals (fig. 3-29). If voltage is present replace buzzer (par 3-57). If voltage is not present, make wiring continuity checks (fig. 6-29).
3. AC POWER switch will not stay on.	Short circuit	Make resistance checks on –12v dc, +12v dc and +26v dc lines to isolate short.
4. LOW SIGNAL alarm is on; RCVR SIG metering reads low.	*a.* Defective power monitor 2A1A5.	*a.* Inject a signal at –65 dbm at the receiver frequency into 2A1A1Z1J1 (fig. 3-16). If the alarm clears replace 2A1A5 (para 3-60).
	b. Defective duplexer 2A1A1	*b.* If the alarm condition remains, inject the signal into P3 (2A1A1A1J2) (fig. 3-18). If

Symptom	Probable cause	Checks and corrective measures
		alarm clears, higher category maintenance is required.
	c. Defective wiring	c. If the alarm condition remains, inject the signal into 2A1A1FL1J1 (fig. 3-18). If the alarm clears, check voltages at pins 1, 2, and 3 on J5 (XPS1P1) (under power supply 2PS1). Pin 1 (+) to pin 2 (-) +12v dc Pin 2 (+) to pin 3 (-) -12v dc
	d. Defective low pass filter 2A1A1FL1.	d. If the alarm condition remains, inject the signal into P1 (2A1A1FL1J2) (fig. 3-18). If the alarm clears replace low pass filter 2A1A1FL1, (para 3-62).
	e. Defective radio frequency amplifier 2A1AR1.	e. If the alarm condition remains, inject signal into P1 (2A1AR1J2) (fig. 3-16). If the alarm clears, check the voltages at pins 1, 2, and 3 on connector J1 (X2A1AR1P2). Voltages should be as in c above. If voltages at J1 (X2A1AR1P2) are normal, replace radio frequency amplifier 2A1AR1 (para 3-59).
	f. Defective bandpass filter assembly 2A1A2A3.	f. If the alarm condition remains, remove frequency mixer stage 2A1A2A2 and inject the signal into connector P2 of 2A1A2A2; connect connector P3 of 2A1A2A2 to J2 (X2A1A2A2P3). If the alarm clears, higher category maintenance is required.
	g. Defective frequency mixer stage 2A1A2A2.	g. If the alarm condition remains, inject a 30 MHz signal at -35 dbm into P1 (XA1A2A2J2). If alarm clears replace 2A1A2A2 (para 3-61).
	h. Defective wiring	h. If the alarm condition remains, inject the signal into P1 (XA1W3J4) (fig. 3-18). If the alarm clears, check voltage between pin 1 (+) and pin 3 (-) of connector J1 of 2A1A2AR1. It should be -12v dc. If the alarm condition remains the fault will be in the remaining module interconnections (fig. 6-29). Check the continuity of signal path to 1RE1AR1. If normal, check voltages at pins 1, 2 and 3 on 1RE1A1J2: Voltages should be as under c above.
5. LOW SIGNAL alarm, RCVR SIG reading low; MULT reading low.	a. Defective wiring	a. Measure power at plus P2 (fig. 3-18) (para 3-30). If abnormal, check wiring between plug P2 or connector 2A1A3 and pin A1 of 1RE1A1A1J3.
	b. Defective frequency multiplier 2A1A2A1.	b. If power at P2 is normal (a above) measure the power at P2 (2A1A2A3J3) (para 3-30). If abnormal, higher category of maintenance is required.
	c. Defective bandpass filter assembly 2A1A2A3.	c. If power at P2 (2A1A2A3J3) is normal, measure power at con-

Symptom	Probable cause	Checks and corrective measures
		nector J2 of 2A1A2A3 (para 3-24). If normal, replace 2A1A2A2 (para 3-61). If abnormal, higher category of maintenance is required.
6. SYNC alarm and/or LOW SIGNAL alarm, RCVR SIG reading low, MULT reading low, OSC reading low.	Defective synthesizer 1RE1A2	Check supply voltages at J3 (X1RE1A2P2). If normal, change synthesizer 1RE1A2 (para 3-56). If abnormal check wiring (fig. 6-29).
7. LOW SIGNAL alarm, RCVR SIG reading low.	Local oscillator frequency off due to—	
	a. Defective synthesizer 1RE1A2	*a.* Check synthesizer (para 3-33).
	b. Defective wiring	*b.* Check wiring from control-indicator 2A2 to J3 (X1RE1A2P2) (fig. 6-29).

3–7. Order Wire Troubleshooting

a. General. To troubleshoot this unit, first remove monitor panel 9A2 (front panel); loosen the four green circled screws that secure the front panel to the order wire case and pull the front panel away from the case (fig. 3–38). Repeat the above procedure to remove distribution panel 9A1 (rear panel) from the case (fig. 3–39). The printed circuit boards remain connected to the rear panel.

NOTE

The complete radio set is required for troubleshooting the order wire equipment. The multiplex equipment may or may not be connected.

b. Order Wire Troubleshooting Chart.

Symptom	Probable cause	Checks and corrective measures
1. Power lamp does not light when receiver AC POWER switch is set to ON.	Defective relay 9A1K1 (fig. 3-39).	Check for 26v dc across the relay coil. If not present, check wiring between relay and 1RE1PS1 (figs. 6-29 and 4-31). If voltage present, check that relay is operated. If not operated, higher category of maintenance is required. If relay is operated, check the wiring between the relay and POWER lamp (fig. 4-31).
2. CALL lamp does not light, buzzer sounds; receiver meter indication is normal with switch at OW.	*a.* Defective wiring	*a.* Check wiring between pins 5 and 6 of 9A2J2 (fig. 3-38).
	b. Defective switch 9A2S2 (fig. 3-38).	*b.* If normal indication is obtained in *a* above, higher category of maintenance is required.
3. CALL lamp lights; buzzer does not sound; receiver meter indication is normal with switch at OW.	*a.* Defective wiring	*a.* Check wiring between pins 5 and 3 of 9A2J2 (fig. 3-38).
	b. Defective switch 9A2S2 (fig. 3-38).	*b.* If normal indication is obtained in *a* above, higher category of maintenance is required.
4. 1600-Hz signaling tone is not heard in handset receiver when the RING button is pressed. No voice communication.	*a.* Defective handset	*a.* Measure the resistance between pin J of 9A1J4 (fig. 3-39) and ground. If other than 25 ohms, replace the handset.
	b. Defective relay 9A1K2 (fig. 3-39).	*b.* Check for 26v across the relay coil. If not present, check the wiring between the relay and 1RE1PS1 (figs. 6-29 and 4-31). If voltage is present, check that the relay is operated. If not operated, higher category of maintenance is required. If relay is operated check interunit wiring (fig. 4-31).
5. 1600-Hz signaling tone is not heard in the handset	Defective switch 9A2S1 (fig. 3-38).	Check switch 9A2S1. If defective, higher category of maintenance

Symptom	Probable cause	Checks and corrective measures
receiver when the RING button is pressed. Voice communication is normal.		is required. If normal, check interunit wiring (fig. 4-31).
6. CALL lamp does not light and buzzer does not sound when the distant station RING button is pressed. Receiver meter indication is normal with switch at OW. Voice communication is normal.	Defective wiring	Check for continuity from terminal E2 of 9A2A1 (fig. 3-38) to pin D of 9A1J3.

3–8. Power Supply 5TR1PS1

a. Test Equipment Required.

Equipment	Common name
Multimeter TS-352B/U	Multimeter
Voltmeter, Electronic ME-30A/U	VTVM
Cable Assembly Special Purpose, Electrical	CMC 456-926

b. Operational Checks.

(1) Remove power supply 5TR1PS1 as described in paragraph 3–47.

(2) Connect power supply 5TR1PS1 to radio transmitter 5TR1 using the CMC 456–926 cable between connectors 5TR1PS1P1 and J3 (X5TR1–PS1P1) (fig. 3–1).

(3) Set the transmitter AC POWER switch to ON/RESET.

(4) Using the multimeter, measure the dc voltages at the test points on voltage regulator amplifier 5TR1PS1AR1, as shown in the chart below:

Test point	Volts
TP1(–) and TP7(+)	28 ±0.2
TP1(–) and TP8(+)	12 ±0.1

WARNING

Be extremely careful when working with the safety cover removed, 600 volts dc is exposed.

(5) Carefully remove the smaller of the two red safety covers labeled DANGER 600V WHEN COVER REMOVED.

(6) Using the multimeter, measure the dc voltages at the filters, as shown in the following chart. Filter terminals are shown in figure 3–2.

Filter terminals	Volts
16 (–) and 17 (+)	26 ±5
22 (–) and 23 (+)	6.8 ±0.4
20 (–) and 21 (+)	6.8 ±0.4
GRD and 24 (+)	630 ±31.5

(7) Using the VTVM, measure the 400–Hz ac voltages at the filters, as shown in the chart below.

Filters	Volts
5 and 6	140 ±5
7 and 8	29 ±5
8 and 9	29 ±5

(8) Set the transmitter AC POWER switch to OFF. Reinstall the red safety cover. Replace 5TR1PS1 if indications in (4), (6), or (7) above are incorrect. Refer to paragraph 3–47 for replacement procedures.

3–9. Amplifier-Monitor 5TR1A5

a. Test Equipment Required.

Equipment	Common name
Generator, Signal AN/USM-205	Wide range oscillator
Oscilloscope AN/USM-140	Oscilloscope
Adapter-Connector UG-274/U	
Cable Assembly, Radio Frequency (2 required)	CMC 456-930
Cable Assembly, Special Purpose, Electrical	CMC 456-916
Cable Assembly, Special Purpose, Electrical	CMC 456-917
Cable Assembly, Special Purpose, Electrical	CMC 456-920

b. Operational Checks.

(1) Remove amplifier-monitor 5TR1A5 as described in chapter 6 of TM 11–5820–540–12.

(2) Connect amplifier-monitor 5TR1A5 to radio transmitter 5TR1, using the CMC 456–920 cable between connectors 5TR1A5P1 and J2 (X5TR1A5P1 (fig. 3–3).

(3) Loosen the four screws securing 5TR1A5 cover plate. Remove the cover plate.

(4) Connect the test equipment as shown in figure 3–4.

(5) Set the frequency of the wide range oscillator to 10 kHz and adjust the amplitude to 2

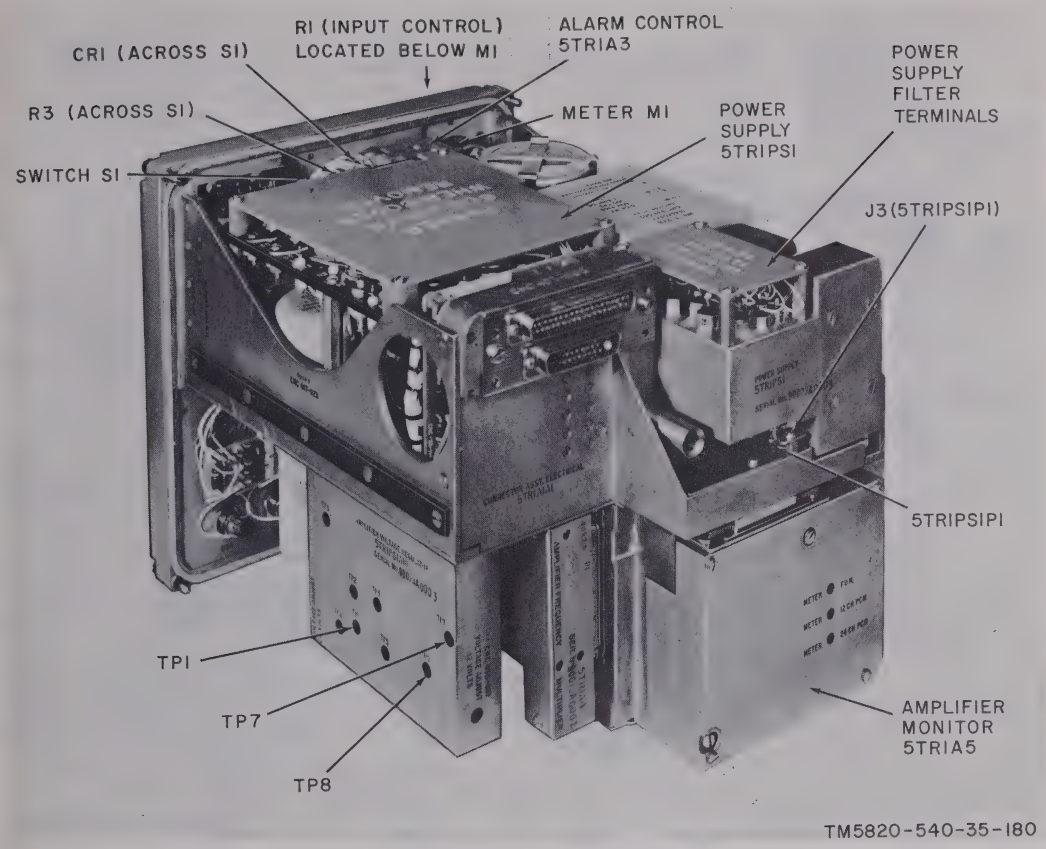


Figure 3-1. Radio transmitter 5TR1, top rear view.

volts peak-to-peak as measured on the oscilloscope. Disconnect the oscilloscope.

(6) Set the transmitter RF head XMTR CHANNEL control to channel 179.

(7) Set the transmitter AC POWER switch to ON/RESET.

(8) Set the transmitter meter switch to 12 CH PCM, 24 CH PCM, and FDM in turn. In each meter switch position, adjust the transmitter INPUT control for a 50 percent of full scale deflection on the transmitter meter.

(9) In each meter switch position of (8) above, measure the voltage at terminal E4 of video amplifier 5TR1A5AR1 board, using the oscilloscope probe. The voltages should be as shown in the chart below.

Meter switch position	Voltage at E4 (volts)
12 CH PCM	0.18 (peak)
24 CH PCM	0.3 (peak)
FDM	0.075 (peak)

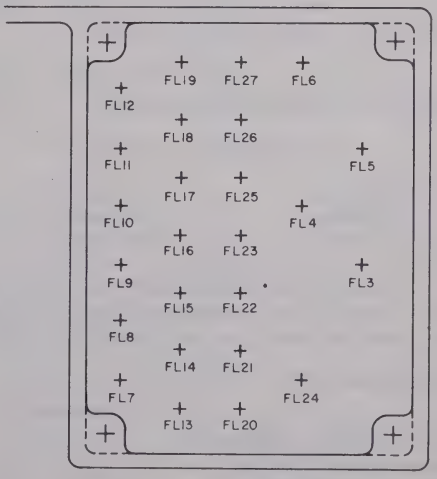


Figure 3-2. Power supply 5TR1PS1, filter terminals location.

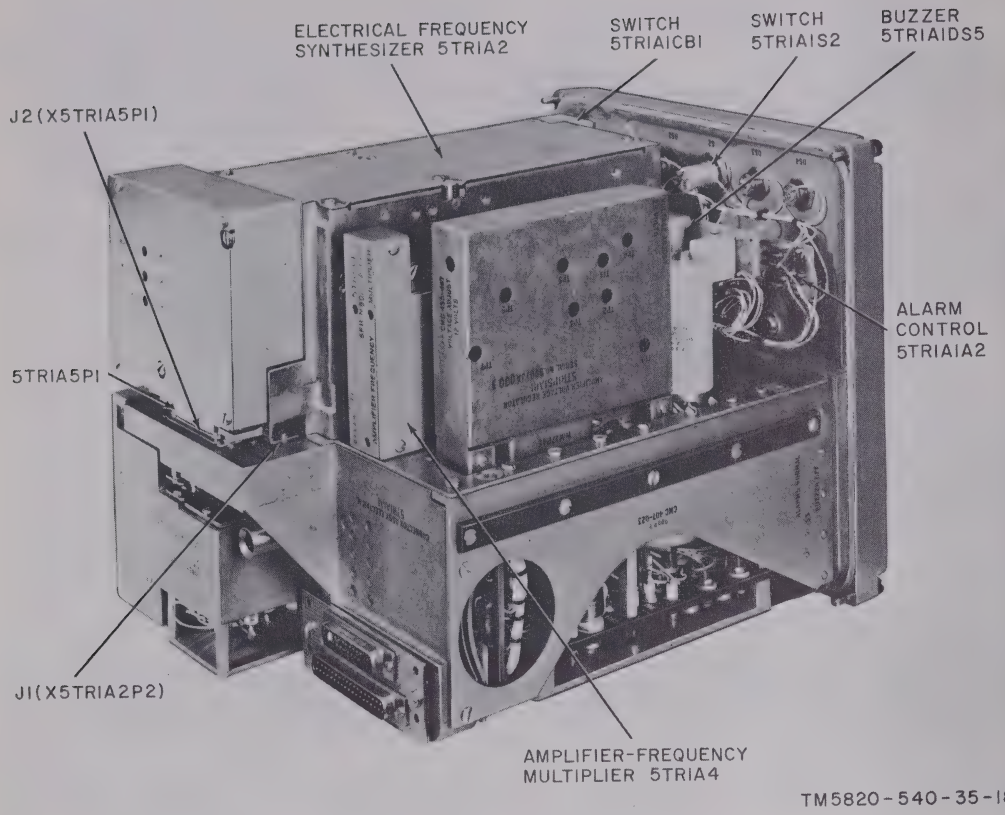


Figure 3-3. Radio transmitter 5TR1, bottom rear view.

(10) Set the transmitter RF head XMTR CHANNEL control to channel 180.

(11) Repeat (8) above.

(12) Repeat (9) above. The voltages should be as shown in the chart below.

Meter switch position	Voltage at E4 (volts)
12 CH PCM	.0.12 (peak)
24 CH PCM	.0.2 (peak)
FDM	.0.05 (peak)

(13) Set the AC POWER switch to OFF. Reinstall the 5TR1A5 cover plate. Replace 5TR1A5 if the indications in (9) or (12) above are abnormal. Refer to chapter 6 of TM 11–5820–540–12 for replacement procedures.

3–10. Electrical Frequency Synthesizer 5TR1A2

NOTE

The troubleshooting of electrical frequency synthesizer 5TR1A2 also involves checking control-indicator 6A3. If abnormal indications are obtained in any of the following tests, troubleshoot control-indicator 6A3 as described in paragraph 3–13 before replacing electrical frequency synthesizer 5TR1A2.

a. Test Equipment Required.

Equipment	Common name
Generator, Signal AN/USM-205	.Wide range oscillator
Oscilloscope AN/USM-140	.Oscilloscope
Meter, Modulation ME-57/U	.Deviation meter
Counter, Electronic Digital Readout AN/USM-207	.Counter
Wattmeter AN/URM-98	.Power meter

Equipment	Common name
Attenuator, fixed, 10 db, Microlab AD-10 MN	
Load, 51 ohms ±2%, BNC male termination 335-053	
Cable Assembly, Radio Frequency (3 required)	CMC 456-930
Cable Assembly, Special Purpose, Electrical	CMC 456-916
Cable Assembly, Special Purpose, Electrical	CMC 456-917
Cable Assembly, Special Purpose, Electrical	CMC 456-925
Cable Assembly, Radio Frequency	CMC 335-057
Cable Assembly, Radio Frequency	CMC 335-283
Adapter-Connector UG-29B/U	
Adapter-Connector UG-201A/U (2 required)	
Adapter-Connector UG-274/U (2 required)	

b. Test Setup.

(1) Remove electrical frequency synthesizer 5TR1A2 as described in paragraph 3–45.

(2) Remove amplifier-frequency multiplier 5TR1A4 from 5TR1A2 as described in paragraph 3–46.

(3) Connect electrical frequency synthesizer 5TR1A2 to radio transmitter 5TR1 using the CMC 456–925 cable between connectors 5TR1A2P2 and J1 (X5TR1A2P2) (fig. 3–3).

c. Frequency Measurements.

(1) Connect the test equipment as shown in figure 3–5A.

(2) Set the AC POWER switch to ON/RESET.

(3) Using the XMTR CHANNEL control on the transmitter rf head, sequentially select the channels indicated in the chart below and read the corresponding frequencies on the counter.

Channel	Frequency (MHz)	Tolerance (Hz)
40	55.000	±550.0
111	63.875	±630.0
112	64.000	±640.0
179	72.375	±720.0
180	48.333	±480.0
410	68.333	±680.0

d. Output Power Measurement.

(1) Disconnect the counter from the test setup of *c* above.

(2) Connect the power meter probe to the 10-db attenuator as shown in figure 3–5B.

(3) Measure the power output at channels 170 and 180. Set the channels using the XMTR CHANNEL control. The power output indication on the power meter should be as shown in the chart below.

Channel	Power Output
179	12 dbm ±1 db
180	16 dbm ±1 db

e. Frequency Deviation Measurement.

(1) Disconnect the power meter from the test setup of *d* above.

(2) Connect the deviation mixer to the 10 db attenuator as shown in figure 3–5C.

(3) Set the frequency of the wide range oscillator to 10 kHz and adjust the amplitude to 2 volts peak-to-peak as measured on the oscilloscope.

(4) Set the transmitter meter switch to 24 CH PCM and adjust the INPUT control for a 50 percent of full scale deflection of the meter.

(5) Measure the frequency deviation at channels 179 and 180. Set the channels using the XMTR CHANNEL control. The frequency deviation indication on the deviation meter should be as shown in the chart below.

Channel	Frequency (kHz)
179	75, +25 –13.5
180	50, +16.6 –9

f. Conclusion of Operational Checks. Set the transmitter AC POWER switch to OFF. Troubleshoot control-indicator 6A3 as described in paragraph 3–13 if abnormal indications are obtained in either *c*, *d*, or *e* above to insure that electrical frequency synthesizer 5TR1A2 and not control-indicator 6A3 is defective. Reinstall amplifier-frequency multiplier 5TR1A4 on 5TR1A2, or on the 5TR1A2 replacement, as described in paragraph 3–46. Reinstall 5TR1A2 as described in paragraph 3–45.

3–11. Amplifier-Frequency Multiplier 5TR1A4

a. Test Equipment Required.

Equipment	Common name
Test Set, Radio Frequency Power AN/URM-120	Wattmeter
Adapter-Connector UG-29B/U	
Adapter-Connector UG-201A/U (2 required)	
Cable Assembly, Radio Frequency	CMC 335-057
Cable Assembly, Radio Frequency	CMC 335-056
Cable Assembly, Special Purpose, Electrical	CMC 456-918

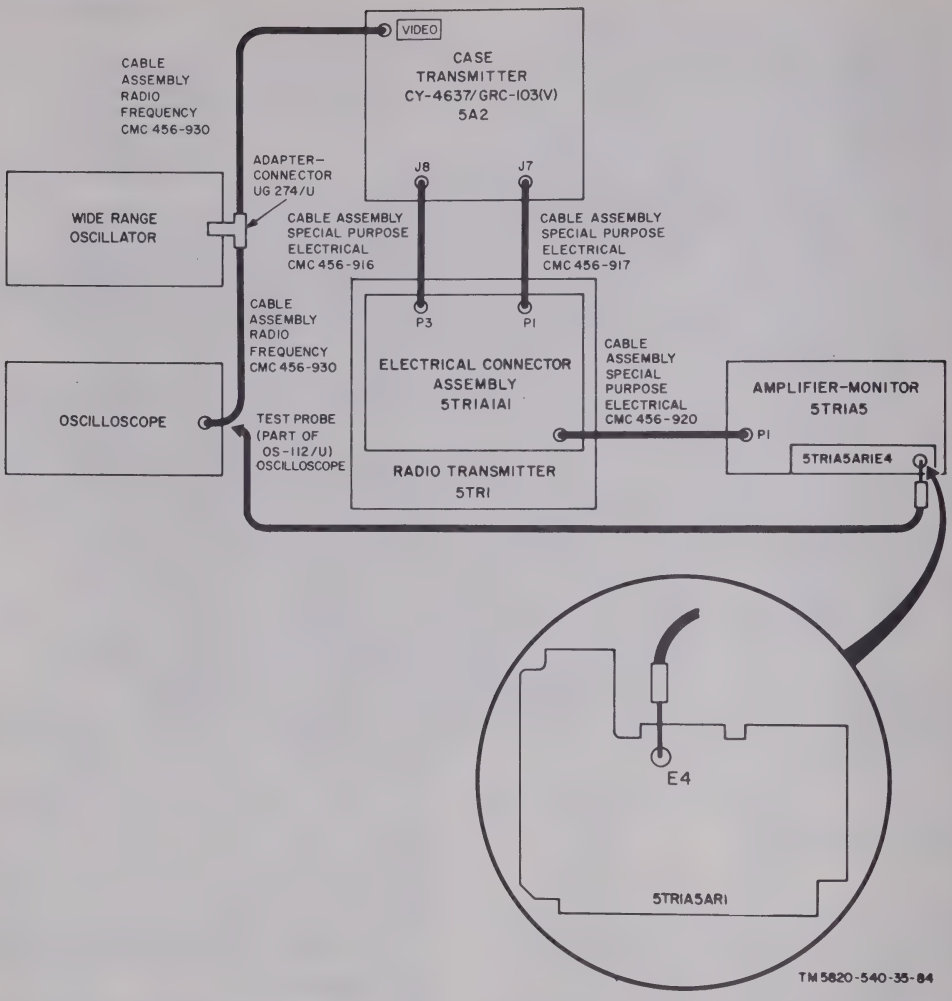


Figure 3-4. Amplifier-monitor 5TR1A5, operational test setup.

b. Operational Check.

(1) Remove the transmitter RF head from the transmitter case and remove the dust cover, as described in chapter 6 of TM 11-5820-540-12.

(2) Connect the transmitter RF head to the transmitter case using the CMC 456-918 cable.

(3) Disconnect RF lead P2 (XA1J5) from connector J5 on electronic switch 6A1 (fig. 3-6).

(4) Connect P2 (XA1J5) to the wattmeter input and the wattmeter output to connector J5 of 6A1 as shown in figure 3-7.

(5) Insert the 10-to 500-watt probe into the wattmeter.

(6) Set the transmitter AC POWER switch to ON/RESET.

(7) Set the XMTR CHANNEL control to channel 179. The wattmeter should indicate no less than 2.5 watts.

(8) Set XMTR CHANNEL control to channel 180. The wattmeter should indicate no less than 2.5 watts.

(9) Set the AC POWER switch to OFF. Replace 5TR1A4 if abnormal indications are obtained in (7) and (8) above, refer to paragraph 3-46 for replacement procedures.

3–12. Alarm Control 5TR1A3

NOTE

The operation of alarm control 5TR1A3 depends on the dc input from power monitor 6AR1A3.

a. Test Equipment Required.

Equipment	Common name
Multimeter TS-352B/U	Multimeter
Cable Assembly, Special Purpose, Electrical	CMC 456-951

b. Operational Check.

(1) Remove alarm control 5TR1A3 as described in chapter 6 of TM 11–5820–540–12.

(2) Connect the alarm control to radio transmitter 5TR1, using the CMC 456–951 cable between connectors 5TR1A3J1 and P2 (5TR1A3–J1).

(3) Remove the cover of 5TR1A3.

(4) Set the XMTR CHANNEL and XMTR TUNE controls to channel 180.

(5) Set the AC POWER switch to ON/RESET.

(6) Set the meter switch to DRIVER and adjust the PWR OUT PEAK control for a maximum indication on the transmitter meter.

(7) Set the meter switch to PWR OUT and adjust the PWR OUT PEAK control for a maximum indication on the transmitter meter.

(8) Using the multimeter, measure the voltage at the terminals of 5TR1A3A1 (printed circuit board) as shown in the chart below.

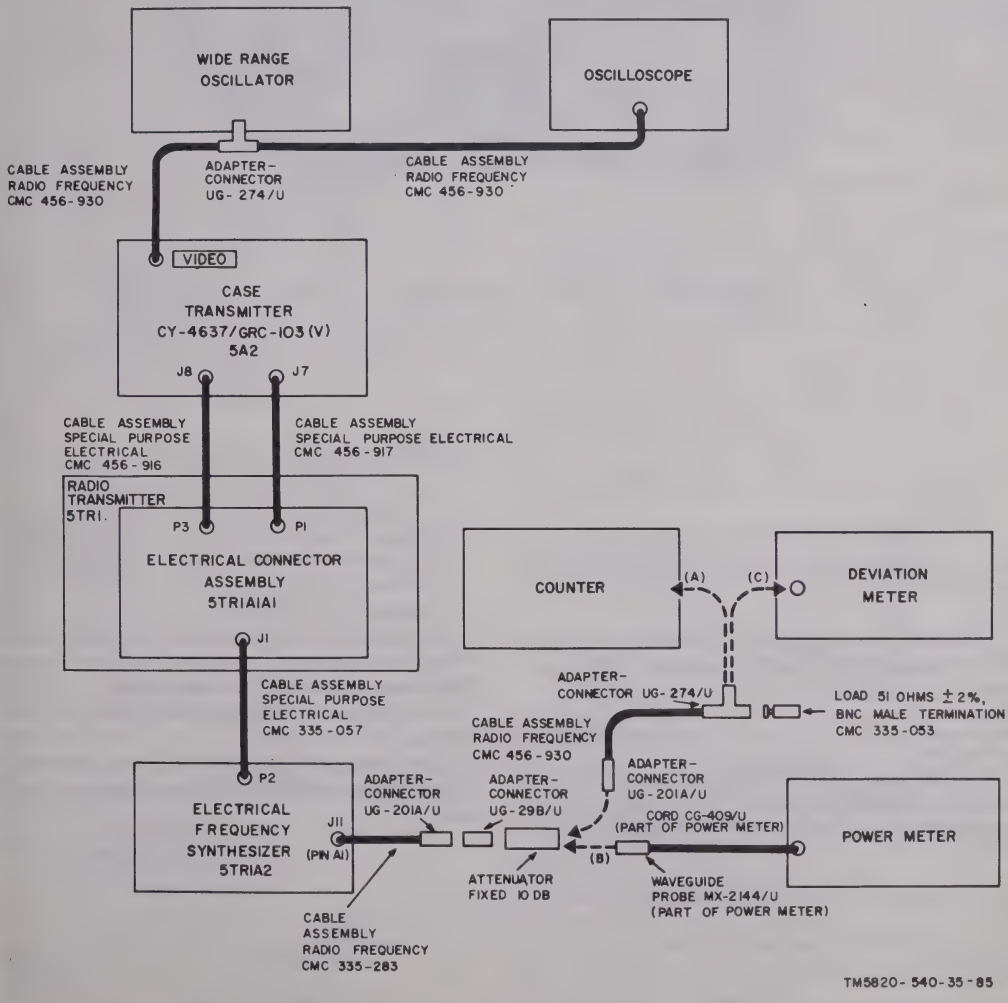


Figure 3-5. Electrical frequency synthesizer 5TR1A2, operational check setup.

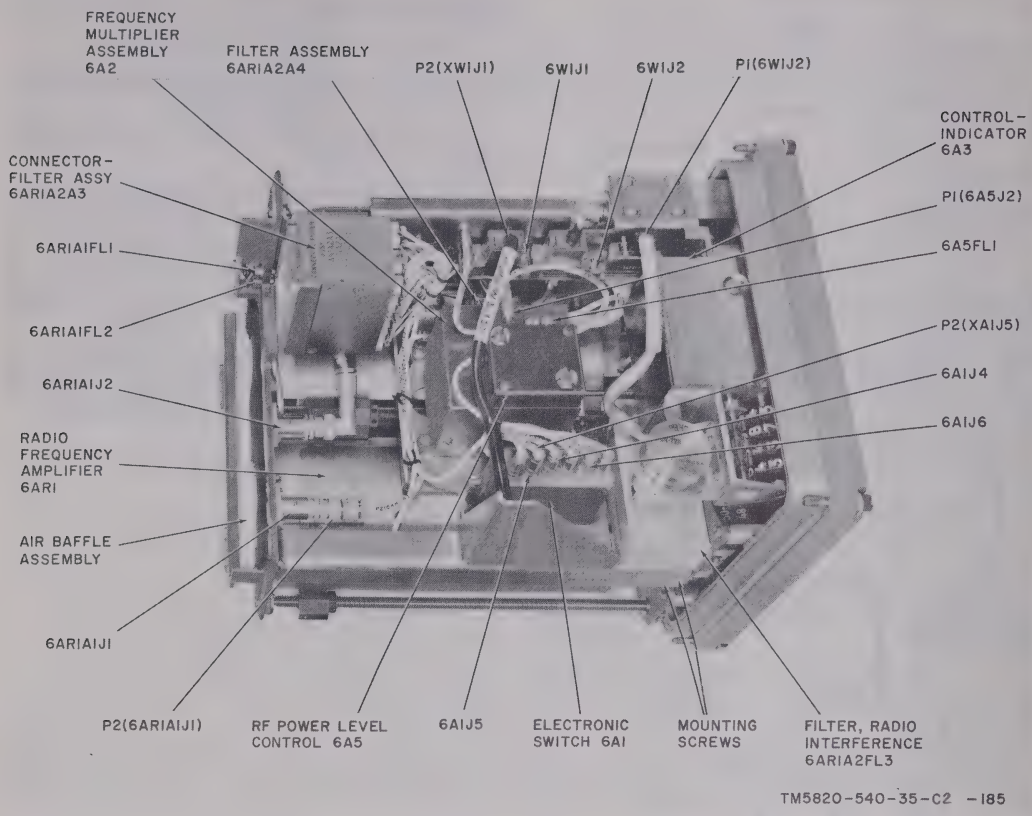


Figure 3-6. Transmitter RF head, top view.

Terminal	Voltage
E6 and ground	Greater than 170 millivolts
E1 and ground	26 v dc

(9) Rotate the XMTR TUNE control until the transmitter meter indicates zero. The LOW POWER lamp should light. The buzzer may sound; mute the buzzer.

(10) Using the multimeter, measure the voltage at the terminals of 5TR1A3A1 as shown in the chart below.

Terminal	Voltage
E6 and ground	Less than 120 millivolts
E1 and ground	0

(11) Set the AC POWER switch to OFF. If abnormal indications are obtained, replace 5TR1A3 as described in chapter 6 of TM 11-5820-540-12.

3-13. Control-Indicator 6A3

a. Test Equipment Required.

Equipment	Common name
Multimeter TS-352B/U	Multimeter
Cable Assembly, Special Purpose, Electrical	CMC 456-922

b. Operational Checks.

(1) Loosen the two screws securing plug P1 (6W1J2) to chassis connector 6W1J2 (fig. 3-6). Disconnect P1 (6W1J2) from 6W1J2.

(2) Set the SMTR CHANNEL control to channel 112.

(3) Using the multimeter, check between the following pins of P1 (6W1J2) as shown in the chart below.

Pins	Resistance
3 and 14	Infinity
4 and 14	Infinity
5 and 14	Infinity
6 and 14	Infinity
7 and 14	Infinity
8 and 14	Infinity
9 and 14	Infinity
10 and 14	Infinity
11 and 14	Infinity
12 and 14	Zero

(4) Set the XMTR CHANNEL control to channel 111.

(5) Using the multimeter, check between the following pins of P1 (6W1J2) in the chart below.

Pins	Resistance
3 and 14	Zero
4 and 14	Zero
5 and 14	Zero
6 and 14	Zero
7 and 14	Zero
8 and 14	Zero
9 and 14	Zero
10 and 14	Zero
11 and 14	Zero
12 and 14	Infinity

(6) Remove control-indicator 6A3 from the transmitter rf head as described in chapter 6 of TM 11–5820–540–12.

(7) Connect plug P1 (6W1J2) to chassis connector 6W1J2, using the CMC 456–922 cable.

(8) Remove the four screws securing the control-indicator cover and remove the cover.

(9) Set the AC POWER switch to ON/RESET.

(10) Set control-indicator 6A3 to channel 179.

(11) Using the multimeter, check the voltage at terminal E12 on command signal decoder 6A3A2. The multimeter should indicate 0 volt.

(12) Set control-indicator 6A3 to channel 180.

(13) Using the multimeter, check the voltage at terminal E12 on 6A3A2. The indication should be +26 volts dc.

(14) Set the AC POWER switch to OFF. Reinstall the control-indicator cover. If abnormal indications are obtained in either (3), (5), or (13) above, replace control-indicator 6A3. Refer to chapter 6 of TM 11–5820–540–12 for replacement procedures.

3–14. Electronic Switch 6A1

a. Test Equipment Required.

Equipment	Common name
Multimeter TS-352B/U	Multimeter
Test Set, Radio Frequency Power AN/URM-120	
Wattmeter AN/URM-98	Power meter
Attenuator, fixed, 20 db Texscan FP-50	20 db attenuator
Adapter-Connector UG-201A/U (2 required)	
Adapter-Connector UG-29B/U (2 required)	
Cable Assembly, Special Purpose, Electrical	CMC 456-918
Cable Assembly, Radio Frequency	CMC 335-056
Cable Assembly, Radio Frequency	CMC 335-057

b. Operational Checks.

(1) Loosen the two screws that secure plug P2 (XW1J1) to chassis connector 6W1J1 (fig. 3–6). Disconnect plug P2 (XW1J1) from connector 6W1J1.

(2) Set the AC POWER switch to ON/RESET.

(3) Set the XMTR CHANNEL control to channel 179.

(4) Using the multimeter, check the voltage between pin 6 (–) and pin 7 (+) of 6W1J1. The multimeter should indicate 26 volts.

(5) Set the XMTR CHANNEL control to channel 180.

(6) Again check the voltage between pin 6 (–) and pin 7 (+) of 6W1J1. The multimeter should indicate 0 volt.

(7) Check between the remaining pins of 6W1J1 as shown in the chart below.

Pins	Voltage (dc)
3 (+) and 1 (–)	+26
3 (+) and 5 (–)	+26
7 (+) and 5 (–)	+26

(8) Set the AC POWER switch to OFF.

(9) Reconnect plug P2 (XW1J1) to connector 6W1J1.

(10) Disconnect plug P1 (XA1J4) from connector J4 on 6A1 (fig. 3–6).

(11) Connect the test equipment as shown in figure 3–8A.

(12) Insert the 10- to 500-watt probe into the wattmeter.

(13) Set the XMTR CHANNEL control to channel 179.

(14) Set the transmitter AC POWER switch to ON/RESET. The wattmeter should indicate no less than 2.5 watts.

(15) Set the AC POWER switch to OFF.

(16) Reconnect plug P1 (XA1J4) to connector 6A1J4.

(17) Disconnect plug P3 (XA1J2) from connector 6A1J2.

(18) Connect the test equipment as shown in figure 3–8B.

(19) Set the XMTR CHANNEL control to channel 180.

(20) Set the AC POWER switch to ON/RESET. The wattmeter should indicate no less than 2.5 watts.

(21) Set the AC POWER switch to OFF.

(22) Reconnect plug P3 (XA1J2) to connector 6A1J2.

(23) Disconnect plug P1 (XA1J6) from connector 6A1J6.

(24) Connect the test equipment as shown in figure 3–8C.

(25) Set the XMTR CHANNEL and XMTR TUNE controls to channel 179.

(26) Set the AC POWER switch to ON/RESET. The level at 6A1J6 should be no less than 26.5 dbm (power meter reading of 6.5 dbm).

(27) Set the XMTR CHANNEL and XMTR TUNE controls to channel 180. The level at 6A1J6 should be no less than 26.5 dbm (power meter reading of 6.5 dbm).

(28) Set the AC POWER switch to OFF. If abnormal indications are obtained in either (4), (6), or (7) above, check control-indicator 6A3 (para 3–13). If abnormal indications are obtained in (14) and (20) above, check frequency multiplier assembly 6A2 (paragraph 3–15) before changing electronic switch 6A1. Replace electronic switch 6A1 if remaining requirements are not met. Refer to chapter 6 of TM 11–5820–540–12 for replacement procedures.

3–15. Frequency Multiplier Assembly 6A2

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM-98	Power meter
Attenuator, fixed, 20 db Texscan FP-50	20 db attenuator
Cable Assembly, Special Purpose, Electrical	CMC 456-918
Cable Assembly, Radio Frequency	CMC 335-056
Adapter-Connector UG-201A/U	
Adapter-Connector UG-29B/U	

b. Operational Check.

(1) Disconnect plug P2 (XA1J3) from connector J3 of electronic switch 6A1.

(2) Connect the test equipment as shown in figure 3–9A.

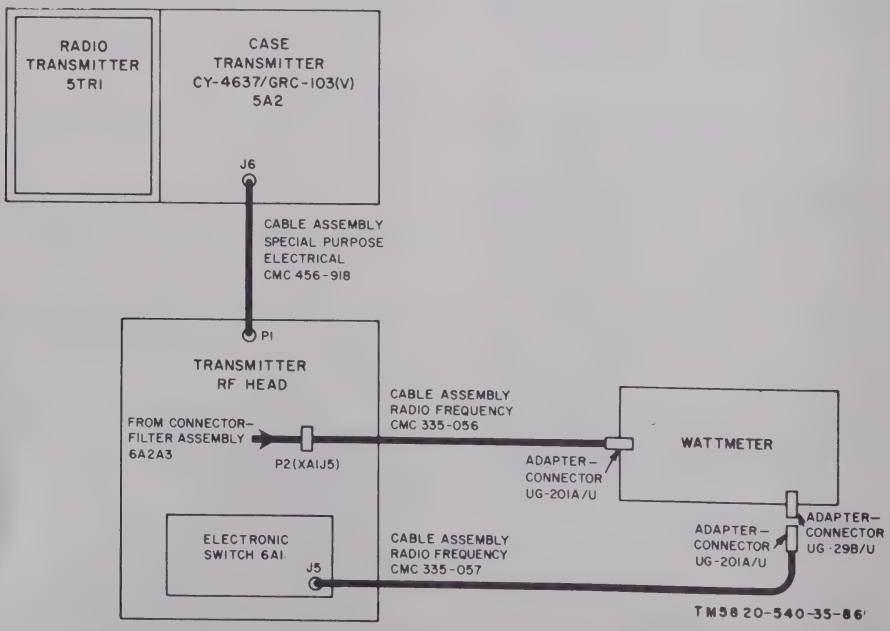


Figure 3-7. Amplifier-frequency multiplier 5TR1A4, operational check setup.

(3) Set the XMTR CHANNEL and XMTR UNE controls to channel 179.

(4) Set the transmitter AC POWER switch › ON/RESET. The level at 6A1P2 should be o less than 26.5 dbm (power meter indication f 6.5 dbm).

(5) Set the AC POWER switch to OFF.

(6) Reconnect plug P2 (XA1J3) to connec- or 6A1J3.

(7) Disconnect plug P4 (QA1J1) from con- ector 6A1J1.

(8) Connect the test equipment as shown in igure 3–9B.

(9) Set the XMTR CHANNEL and XMTR 'UNE controls to channel 180.

(10) Set the AC POWER switch to ON/RE- ET. The level at 6A1P4 should be no less than 6.5 dbm (power meter indication of 6.5 dbm).

(11) Set the AC POWER switch to OFF. Re- lace frequency multiplier assembly 6A2, if bnormal indications are obtained in either (4) r (10) above. Refer to paragraph 3–53 for re- lacement procedures.

–16. RF Power Level Control 6A5

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM-98	Power meter
Multimeter TS-352B/U	Multimeter
Attenuator, fixed, 20 db, Texscan FP-50	20 db attenuator
Cable Assembly, Special Purpose, Electrical	CMC 456-918
Cable Assembly, Radio Frequency	CMC 335-057
Adapter-Connector UG-201A/U	
Adapter-Connector UG-29B/U	

b. Operational Check.

(1) Disconnect plug P1 (6A5J2) from con- ector J2 of the RF power level control 6A5 fig. 3–6).

(2) Connect the test equipment as shown n figure 3–10.

(3) Set the AC POWER switch to ON/RE- ET. The level at 6A5J2 should be +23 dbm inimum, (power meter indication of +3 dbm).

(4) Disconnect the power meter and recon- ect P1 (6A5J2) to 6A5J2.

(5) Using the multimeter, check the con- rol voltage at 6A5FL1 (fig. 3–6). The multim- ter should indicate 7.2 volts dc minimum (volt- ge increases as input power increases).

(6) If an abnormal indication is obtained in (3) or (5) above, replace 6A5 as described in paragraph 3–54.

3–17. Filter Assembly 6AR1A2A4

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM-98	Power meter
Test Set, Radio Frequency Power AN/URM-120	Wattmeter
Attenuator, fixed, 20 db, Texscan FP-50	20 db attenuator
Cable Assembly, Special Purpose, Electrical	CMC 456-918
Cable Assembly, Radio Frequency	CMC 335-056
Cable Assembly, Radio Frequency (2 required)	CMC 335-057
Adapter-Connector UG-201A/U (2 required)	
Adapter-Connector UG-29B/U (2 required)	

b. Operational Check.

(1) Disconnect plug P2 (6AR1A2A4J4) from connector J4 on filter assembly 6AR1A2A4 (fig. 3–6).

(2) Connect the test equipment as shown in figure 3–11.

(3) Set the AC POWER switch to ON/RESET. The level at 6AR1A2A4J4 should be +23 dbm minimum, (power meter indication of +3 dbm).

(4) Set the AC POWER switch to OFF.

(5) Reconnect plug P2 (6AR1A2A4J4) to connector J4 on filter assembly 6AR1A2A4.

(6) Disconnect plug P1 (6AR1A2A4J2) from connector J2 on filter assembly 6AR1A2A4.

(7) Connect the test equipment as shown in figure 3–11B.

(8) Set the AC POWER switch to ON/RESET.

(9) Set the transmitter meter switch to the DRIVER position and adjust the PWR OUT PEAK control for maximum indication on the transmitter meter. The wattmeter should indicate no less than 3.5 watts.

(10) Set the AC POWER switch to off.

(11) If abnormal indications are obtained in either (3) or (9) above, higher category of maintenance is required.

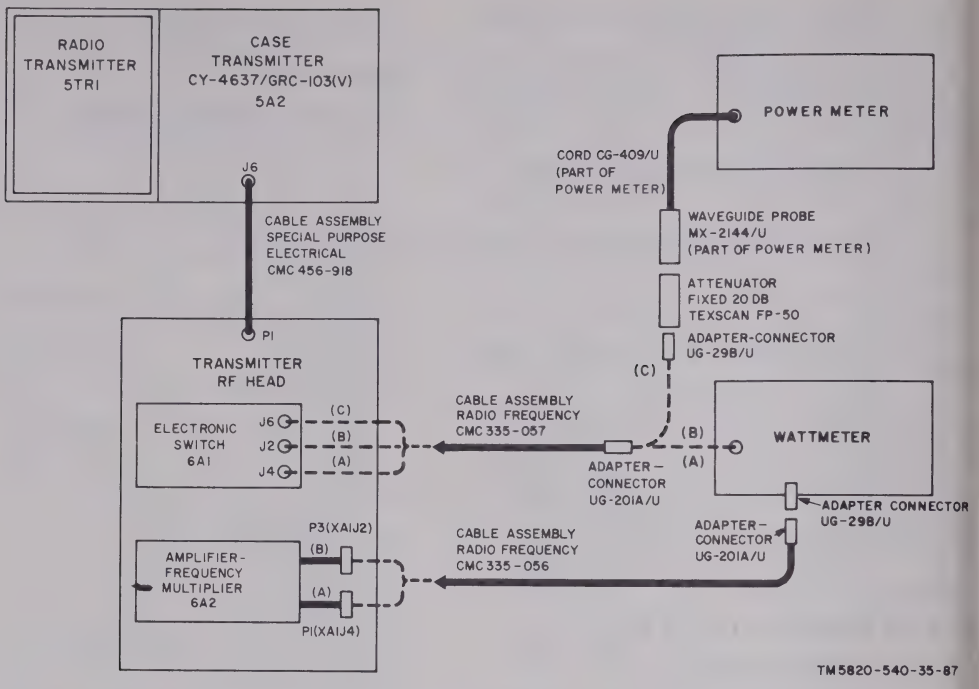


Figure 3-8. Electronic switch 6A1, operational check setup.

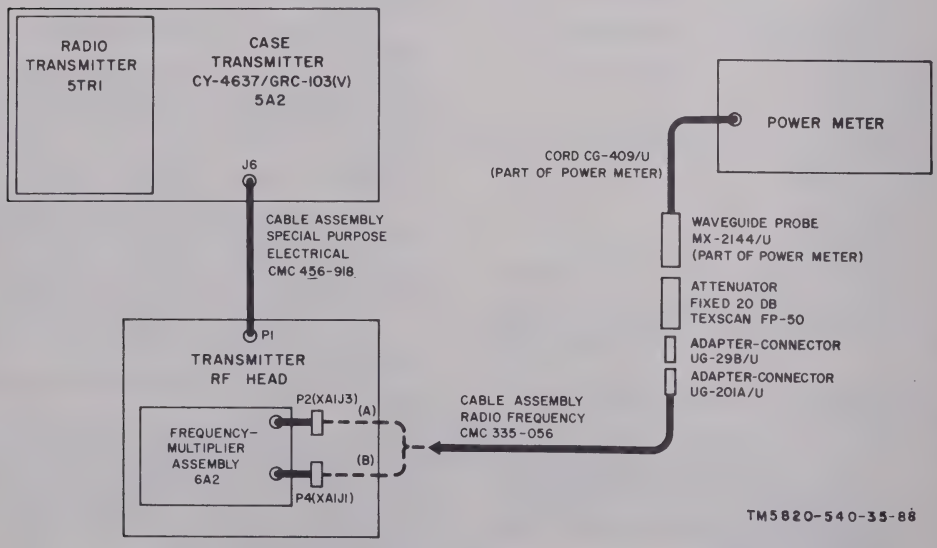


Figure 3-9. Frequency multiplier assembly 6A2, operational check setup.

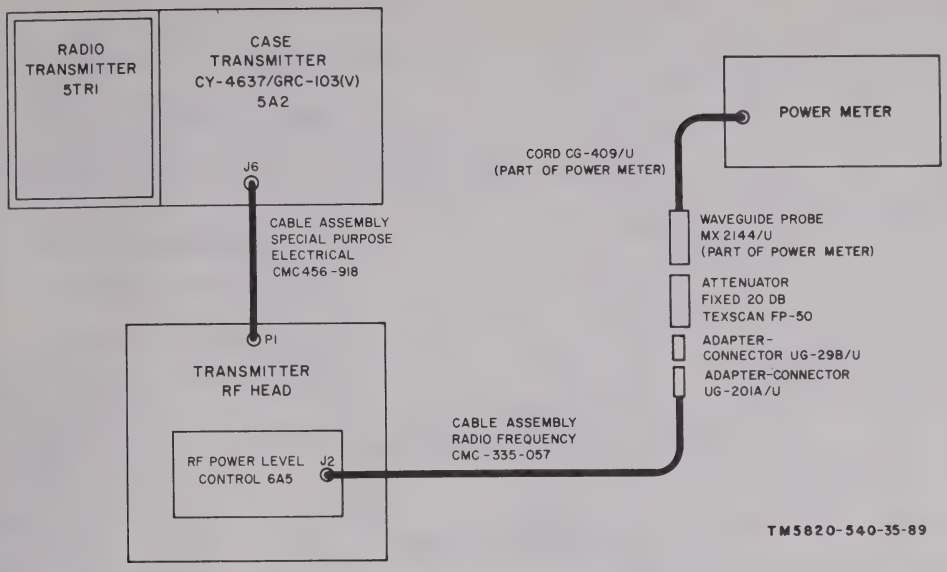


Figure 3-10. RF power level control 6A5, operational check setup.

3–18. Radio Frequency Amplifier 6AR1

a. Test Equipment Required.

Equipment	Common name
Test Set, Radio Frequency Power, AN/URM-120	Wattmeter
Cable Assembly, Special Purpose, Electrical	CMC 456-918
Cable Assembly, Radio Frequency (2 required)	CMC 456-930
Adapter-Connector UG-201A/U (2 required)	
Adapter-Connector UG-29B/U	
Adapter-Connector UG-274/U	

b. Operational Check.

(1) Disconnect plug P2 (6AR1A1J1) from connector J1 on radio frequency amplifier 6AR1 (fig. 3–6).

(2) Connect the test equipment as shown in figure 3–12A.

(3) Insert the 10-to 500-watt probe into the wattmeter.

(4) Set the XMTR CHANNEL and XMTR TUNE controls to channel 180.

(5) Set the transmitter AC POWER switch to ON/RESET and the meter switch to DRIVER.

(6) Adjust the PWR OUT PEAK control for maximum indication on the transmitter meter. The wattmeter should indicate no less than 3.5 watts.

(7) Set the AC POWER switch to OFF.

(8) Reconnect plug P2 (6AR1A1J1) to connector J1 of radio frequency amplifier 6AR1.

(9) Disconnect plug P1 (6AR1A11J2) from connector J2 on 6AR1.

(10) Connect the test equipment as shown in figure 3–12B.

(11) Set the AC POWER switch to ON/RESET.

(12) Set the meter switch to DRIVER and adjust the PWR OUT PEAK control for maximum indication on the transmitter meter.

(13) Set the meter switch to PWR OUT and adjust the PWR OUT PEAK control for maximum indication on the meter. The wattmeter should indicate no less than 25 watts.

(14) Set the AC POWER switch to OFF.

(15) Replace the transmitter RF head if abnormal indications are obtained in (6) and (13) above.

3–19. Circuit Card Assembly 6AR1A2A2

a. Test Equipment Required.

Equipment	Common nam
Multimeter TS-352B/U	Multimeter

b. Operational Check.

(1) Remove the transmitter RF head from its case.

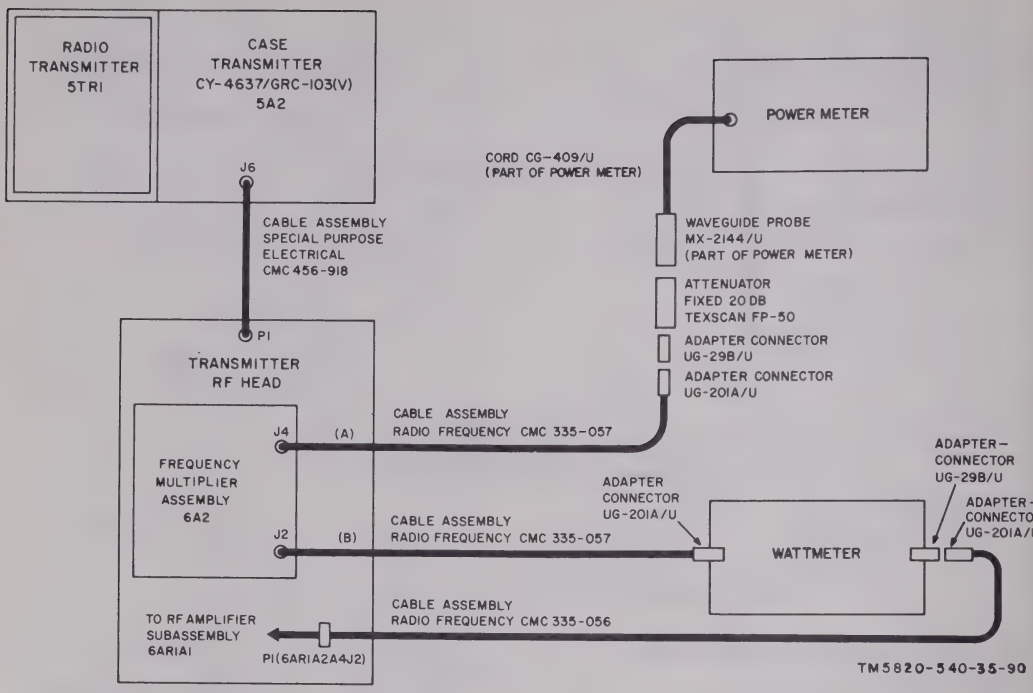


Figure 3-11. Filter assembly 6AR1A2A4, operational check setup.

(2) Using the multimeter, check for correct resistance between the following test points as shown in the chart below.

Test Points	Resistance (ohms ±10%)
E1 and E3	12
E1 and TP5	0
E1 and TP6	12
E1 and TP7	5.1
E1 and E8	5.1
E2 and E10	Infinity
E4 and TP1	0
E4 and E9	200 k
E4 and E11	240 k
E4 and E12	220 k
E5 and TP2	0
E6 and TP3	0
E7 and TP4	0

(3) If abnormal indications are obtained in (2) above, higher category of maintenance is required.

3-20. Low Pass Filter 6AR1A2FL1

a. Test Equipment Required.

Equipment	Common name
Test Set, Radio Frequency Power, AN/URM-120	Wattmeter
Cable Assembly, Special Purpose, Electrical	CMC 456-918
Cable Assembly, Radio Frequency	CMC 456-930
Adapter-Connector UG-201A/U (2 required)	
Adapter-Connector UG-29B/U	

b. Operational Check.

(1) Disconnect plug P2 (XAR1A3J1) from connector J1 of power monitor 6AR1A3, (fig. 3-13).

(2) Connect the test equipment as shown in figure 3-14.

(3) Insert the 10-5 to 500-watt probe into the wattmeter.

(4) Set the XMTR CHANNEL and XMTR TUNE controls to channel 180.

(5) Set the transmitter AC POWER switch to ON/RESET.

(6) Set the transmitter meter switch to DRIVER and adjust the PWR OUT PEAK control for maximum indication on the transmitter meter.

(7) Set the meter switch to PWR OUT and adjust the PWR OUT PEAK control for maximum reading on the meter. The wattmeter should indicate no less than 25 watts.

(8) Set the AC POWER switch to OFF. Replace low pass filter 6AR1A2FL1, if an abnormal indication is obtained in (7) above, refer to paragraph 3–51 for replacement procedures.

3–21. Power Monitor 6AR1A3

a. Test Equipment Required.

Equipment	Common name
Test Set, Radio Frequency Power AN/URM-120.	Wattmeter
Cable Assembly, Radio Frequency	CMC 456-931
Adapter-Connector UG-565A/U	
Adapter-Connector UG-29B/U	
Adapter-Connector UG-564A/U	

b. Operational Check.

(1) Connect the test equipment as shown in figure 3–15.

(2) Insert the 10-to 500-watt probe into the wattmeter.

(3) Set the XMTR CHANNEL and XMTR TUNE controls to channel 180.

(4) Set the transmitter AC POWER switch to ON/RESET.

(5) Set the transmitter meter switch to DRIVER and adjust the PWR OUT PEAK control for maximum indication on the transmitter meter.

(6) Set the meter switch to PWR OUT and adjust the PWR OUT PEAK control for maximum indication on the meter. The wattmeter should indicate no less than 25 watts.

(7) Set the AC POWER switch to OFF. If abnormal indication is obtained, replace power monitor 6AR1A3 as described in paragraph 3–52.

3–22. Bandpass Filter Assembly 2A1A1A1 and Impedance Matching Network 2A1A1Z1

a. Test Equipment Required.

Equipment	Common name
Test Set, Radio Frequency Power AN/URM-120	Wattmeter
Generator, Signal AN/USM-44A	Signal generator
Voltmeter, Electronic ME-30A/U	VTVM
Load, 51 ohms	CMC 335-053
Adapter-Connector UG-201A/U (2 required)	
Adapter-Connector UG-29B/U	
Adapter-Connector UG-274/U	
Cable Assembly, Special Purpose, Electrical	CMC 456-921
Cable Assembly, Radio Frequency (2 required)	CMC 456-930

b. Operational Check—Transmitter Path.

(1) Disconnect plug P2 (XA1A1Z1J1) (fig. 3–16) from connector J1 on impedance matching network 2A1A1Z1.

(2) Connect the test equipment as shown in figure 3–17.

(3) Insert the 10-to 500-watt probe into the wattmeter.

(4) Connect the PWR OUT connector of the transmitter RF head to the FROM XMTR connector of the receiver fixed head.

(5) Set the transmitter AC POWER switch to ON/RESET. The wattmeter should indicate no less than 17 watts.

(6) Set the AC POWER switch to OFF. If an abnormal reading is obtained in (5) above, higher category of maintenance is required.

c. Operational Check—Receiver Path.

(1) Disconnect plug P3 (2A1A1A1J2) (fig. 3–18) from connector J2 on bandpass filter assembly 2A1A1A1.

(2) Connect the test equipment as shown in figure 3–19A.

(3) Set the receiver to channel 200.

(4) Set the frequency of the signal generator to 300 MHz and adjust the output level until a reading of –50 dbm is obtained on the VTVM. Note the attenuator setting on the signal generator.

(5) Reconnect plug P3 (2A1A1A1J2) to connector J2 on bandpass filter assembly 2A1A1–A1.

(6) Disconnect plug P2 (2A1A1Z1J1) (fig. 3–16) connector J1 on impedance matching network 2A1A1Z1.

(7) Connect the test equipment as shown in figure 3–19B.

(8) Increase the output of the signal generator until a reading of –50 dbm is obtained on the VTVM. The output attenuator setting on the signal generator should not be more than 2 db higher than the setting noted in (4) above.

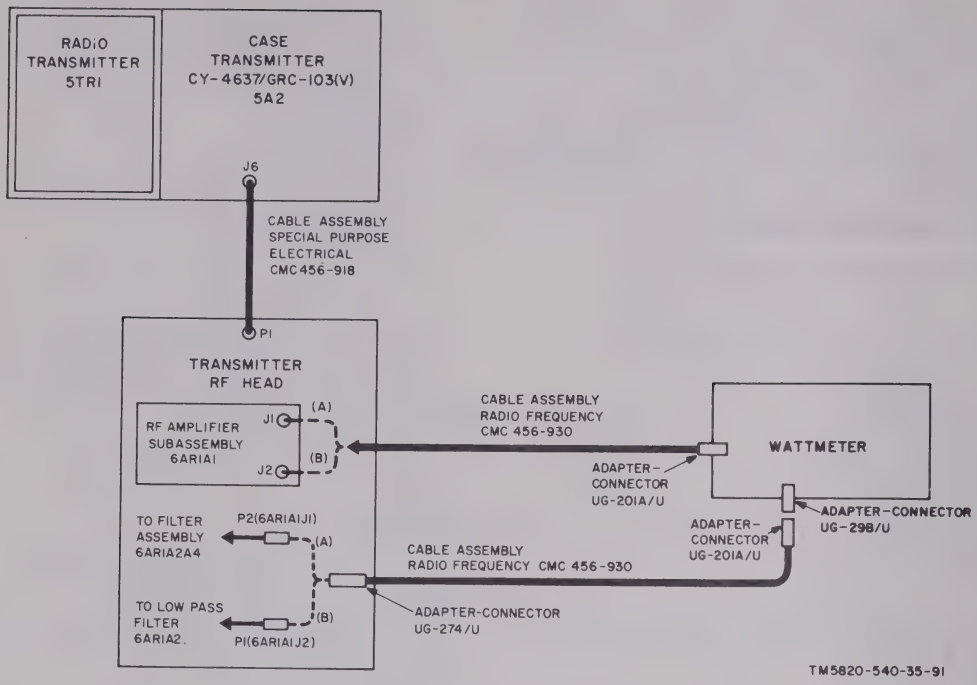


Figure 3-12. Radio frequency amplifier 6AR1, operational check setup.

(9) If the indication in (8) above is not obtained, replace the receiver RF head.

3-23. Power Monitor 2A1A5

a. Test Equipment Required.

Equipment	Common name
Test Set, Radio Frequency AN/URM-120	Wattmeter
Generator, Signal AN/USM-44A	Signal Generator
Voltmeter, Electronic ME-30A/U	VTVM
Load, 51 ohms	CMC 335-053
Adapter-Connector UG-565A/U	
Adapter-Connector UG-29B/U	
Adapter-Connector UG-564A/U	
Adapter-Connector UG-274/U	
Adapter-Connector UG-636A/U	
Cable Assembly, Radio Frequency (2 required)	CMC 456-930
Cable Assembly, Radio Frequency	CMC 456-931
Cable Assembly, Special Purpose, Electrical	CMC 456-921

b. Operational Check—Transmit Path.

(1) Connect the test equipment as shown in figure 3-20.

(2) Insert the 10- to 500-watt probe into the wattmeter.

(3) Set the transmitter AC POWER switch to ON/RESET. The wattmeter should indicate no less than 15.5 watts.

(4) If an abnormal indication is obtained in (3) above, replace 2A1A5 as described in paragraph 3-60.

c. Operational Check—Receive Path.

(1) Disconnect plug P2 (2A1A1Z1J1) (fig. 3-16) from connector J1 of impedance matching network 2A1A1Z1.

(2) Connect the test equipment as shown in figure 3-21.

(3) Tune the receiver to channel 200.

(4) Set the frequency of the signal generator to 300 MHz, and adjust the output until the VTVM indicates -50 dbm.

(5) Reconnect plug P2 (2A1A1Z1J1) to connector J1 of impedance matching network 2A1A1Z1.

(6) Connect the equipment as shown in figure 3-21B. The indication on the VTVM should not be lower than -50.5 dbm.

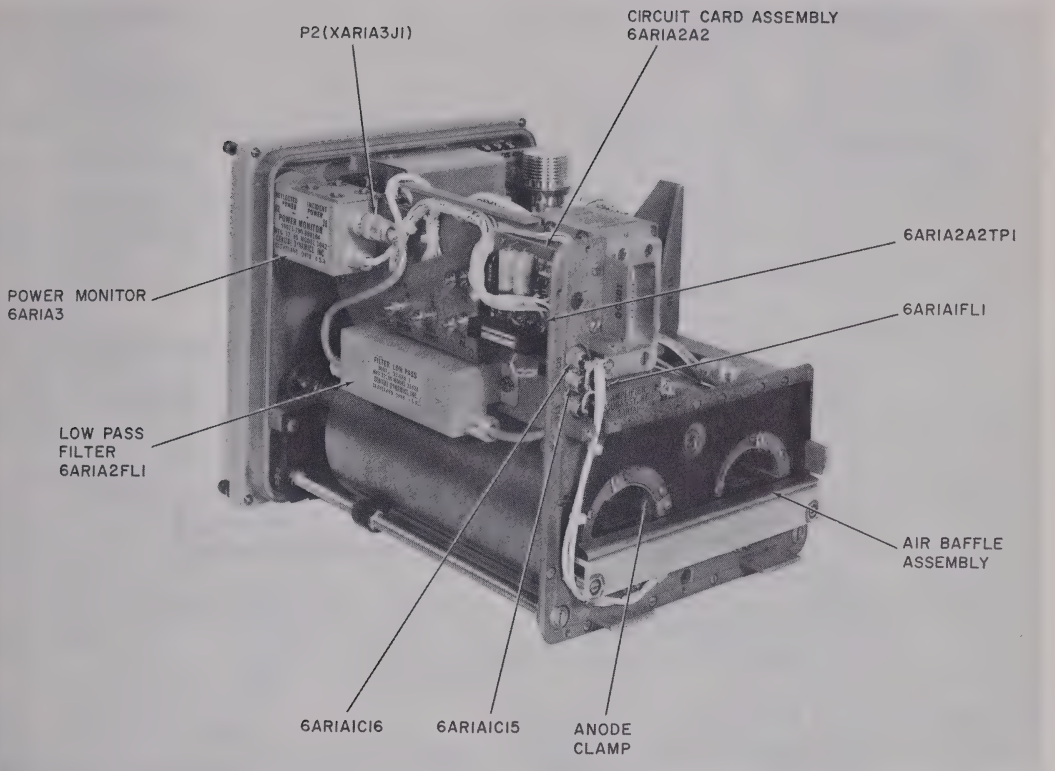


Figure 3-13. Transmitter RF head, side view.

(7) If an abnormal indication is obtained in (6) above, replace power monitor 2A1A5 as described in paragraph 3-60.

3-24. Bandpass Filter Assembly 2A1A2A3

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM-98	Power meter
Generator, Signal AN/USM-44A	Signal generator
Adapter-Connector UG-29B/U	
Adapter-Connector UG-201A/U	
Cable Assembly, Radio Frequency	CMC 335-057
Cable Assembly, Radio Frequency	CMC 335-058
Cable Assembly, Radio Frequency	CMC 456-930
Cable Assembly, Special Purpose, Electrical	CMC 456-921

b. Operational Check.

(1) Remove frequency mixer stage 2A1A2A2 as described in paragraph 3-60.

(2) Disconnect plug P2 (2A1A2A3J4) (fig. 3-18) from connector J4 bandpass filter assembly, 2A1A2A3.

(3) Connect the test equipment as shown in figure 3-22A.

(4) Set the frequency of the signal generator to 300 MHz at a level of −5 dbm.

(5) Set the RCVR SIG control on the receiver RF head to channel 200 and adjust the MULT PEAK control for maximum indication on the power meter. The power meter should indicate −6 dbm minimum.

(6) Connect the test equipment as shown in figure 3-22B.

(7) Set the frequency of the signal generator to 330 MHz. The power meter should indicate −8 dbm minimum.

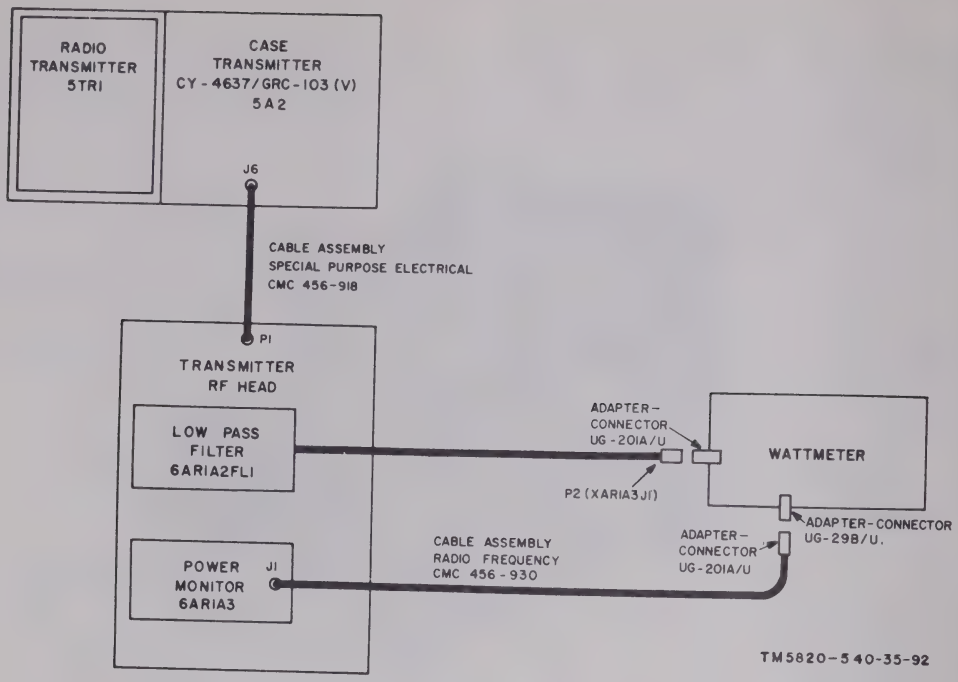


Figure 3-14. Low pass filter 6AR1A2FL1, operational check setup.

(8) If abnormal indications are obtained in (5) and (7) above, replace the receiver RF head.

3-25. Radio Frequency Amplifier 2A1AR1

a. Test Equipment Required.

Equipment	Common name
Voltmeter, Electronic ME-30A/U	VTVM
Generator, Signal AN/USM-44A	Signal Generator
Load, 51 ohms	CMC 335-053
Adapter-Connector UG-274/U	
Cable Assembly, Special Purpose, Electrical	CMC 456-921
Cable Assembly, Radio Frequency (2 required)	CMC 456-930
Cable Assembly, Radio Frequency	CMC 335-055

b. Operational Check.

(1) Disconnect plug P1 (2A1AR1J2) (fig. 3-16) from connector J2 of radio frequency amplifier 2A1AR1.

(2) Connect the test equipment as shown in figure 3-23A.

(3) Tune the receiver RF head to channel 200.

(4) Set the AC POWER switch to ON.

(5) Set the frequency of the signal generator to 300 MHz and adjust the output level until a reading of -50 dbm is obtained on the VTVM.

(6) Connect the test equipment as shown in figure 3-23B.

(7) Decrease the output of the signal generator by 27 db.

(8) The indication on the VTVM should be the same as that obtained in (5) above, ±3 db.

(9) Set the AC POWER switch to OFF.

(10) If the reading specified in (8) above is not obtained, replace radio frequency amplifier 2A1AR1. Refer to chapter 6 of TM 11-5820-540-12 for replacement procedures.

3-26. Low Pass Filter 2A1A1FL1

a. Test Equipment Required.

Equipment	Common name
Signal Generator AN/USM-44A	Signal generator
Voltmeter, Electronic ME-30A/U	VTVM

Equipment	Common Name
Load, 51 ohms	CMC 335-053
Cable Assembly, Special Purpose, Electrical	CMC 456-921
Cable Assembly, Radio Frequency (2 required)	CMC 456-930

b. Operation Check.

(1) Disconnect plug P2 (2A1AR1J1) (fig. 3–16) from connector J1 of radio frequency amplifier 2A1AR1.

(2) Connect the test equipment as shown in figure 3–24*b*.

(3) Tune the receiver rf head to channel 200.

(4) Set the frequency of the signal generator to 300 MHz and adjust the output level for a –50 dbm reading on the VTVM.

(5) Reconnect plug P2 (2A1AR1J1) to connector J1 of radio frequency amplifier 2A1AR1.

(6) Disconnect plug P2 (2A1A1FL1J1) (fig. 3–18) from the connector J1 of low pass filter 2A1A1FL1.

(7) Connect the test equipment as shown in figure 3–24A.

(8) The indication on the VTVM should not be lower than –50.5 dbm.

(9) If an abnormal indication is obtained in (8) above, replace 2A1A1FL1. Refer to chapter 6 of TM 11–5820–540–12 for replacement procedures.

3–27. Electronic Switch 2A4 and Power Supply 2PS1

a. Test Equipment Required.

Equipment	Common name
Voltmeter, Electronic ME-30A/U	Voltmeter
Generator, Signal AN/USM-44A	Signal generator
Load, 51 ohms	CMC 335-053
Adapter-Connector UG-274/U (2 required)	
Cable Assembly, Special Purpose, Electrical	CMC 456-921
Cable Assembly, Radio Frequency (2 required)	CMC 456-930

b. Operational Check.

(1) Disconnect plug P3 (2A1A1A1J2) (fig. 3–18) from connector J2 of bandpass filter assembly 2A1A1A1.

(2) Connect the test equipment as shown in figure 3–25A.

(3) Tune the receiver to channel 200 and the signal generator to 300 MHz.

(4) Set the AC POWER switch to ON.

(5) Increase the output level of the signal generator to a maximum of 0 dbm. The HIGH SIGNAL alarm should operate and the buzzer may sound if it is not muted.

(6) Decrease the level of the signal generator until the VTVM indicates –50 dbm.

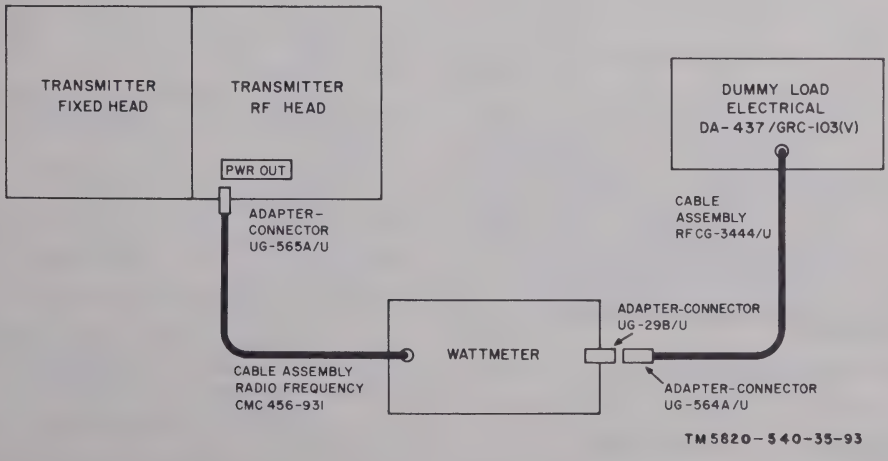


Figure 3-15. Power monitor 6AR1A3, operational check setup.

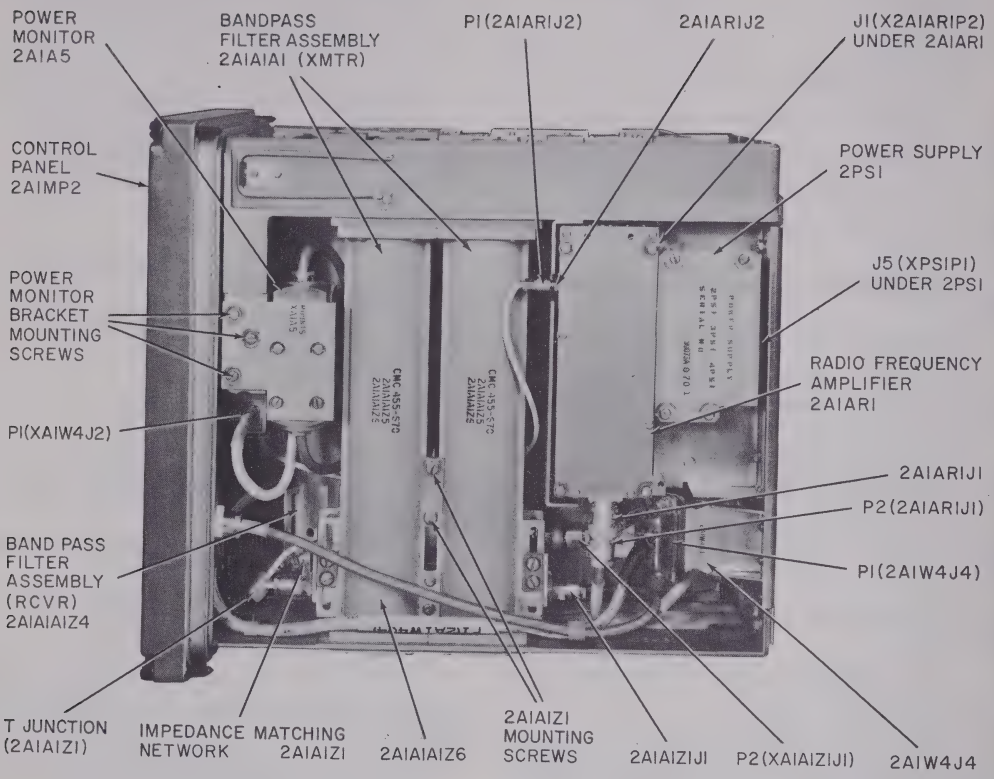


Figure 3-16. Receiver RF head, bottom view.

(7) Connect the test equipment as shown in figure 3–25B.

(8) The indication obtained on the VTVM should not be higher than –49.25 dbm.

(9) Set the AC POWER switch to OFF.

(10) If the HIGH SIGNAL alarm does not come on in (5) above, and/or the indication obtained in (8) above is beyond the specified limit, electronic switch 2A4 and/or power supply 2PS1 should be replaced. Refer to chapter 6 of TM 11–5820–540–12 for replacement procedures.

3–28. Intermediate Frequency Amplifier 2A1A2AR1

a. Test Equipment Required.

Equipment	Common name
Generator, Signal AN/USM-44A	Signal generator
Wattmeter AN/URM-98	Power meter
Adapter-Connector UG-29B/U	
Adapter-Connector UG-201A/U	
Cable Assembly, Special Purpose, Electrical	CMC 456-921
Cable Assembly, Radio Frequency	CMC 335-057
Cable Assembly, Radio Frequency	CMC 335-055
Cable Assembly, Radio Frequency	CMC 456-930

b. Operational Check.

(1) Disconnect plug P1 (XA1A2A2J2) (fig. 3–18) from connector J2 of frequency mixer stage 2A1A2A2. Disconnect P1 (XA1W3J4).

(2) Connect the test equipment as shown in figure 3–26.

(3) Set the frequency of the signal generator to 30 MHz at an output level of –55 dbm.

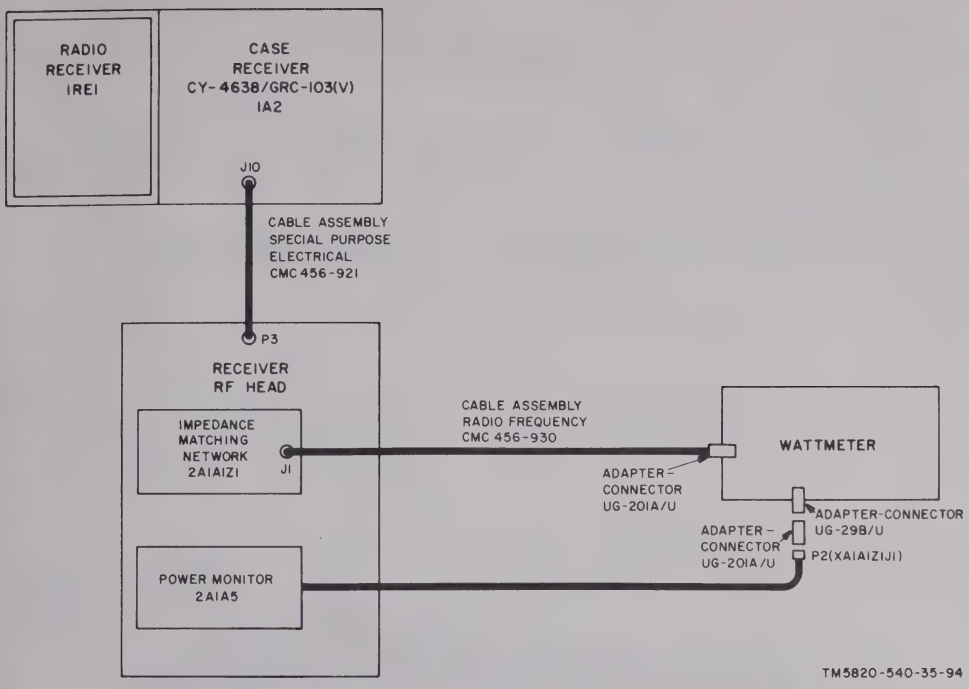


Figure 3-17. Duplexer bandpass filter (transmit) operational check setup.

(4) Set the receiver AC POWER switch to ON. The power meter should indicate between 20 dbm and –5 dbm.

(5) Set the receiver AC POWER switch to OFF.

(6) If the indication obtained in (4) above is outside specified limits, replace intermediate frequency amplifier 2A1A2AR1. Refer to TM 11-5820-540-12, chapter 6, for replacement procedures.

3-29. Frequency Mixer Stage 2A1A2A2

a. Test Equipment Required.

Equipment	Common name
Signal Generator AN/USM-44A	Signal generator
Wattmeter AN/URM-98	Power meter
Adapter-Connector UG-29B/U	
Adapter-Connector UG-201A/U	
Cable Assembly, Special Purpose, Electrical	CMC 456-921
Cable Assembly, Radio Frequency	CMC 456-930
Cable Assembly, Radio Frequency	CMC 335-057
Cable Assembly, Radio Frequency	CMC 335-055

b. Operational Check.

NOTE

Intermediate frequency amplifier 2A1A2AR1 and bandpass filter assembly 2A1A2A3 must be serviceable for this check. Check as described in paragraphs 3-28 and 3-24 respectively.

(1) Disconnect plug P2 (2A1A2A3J4) (fig. 3-18) from connector J4 of bandpass filter assembly 2A1A2A3.

(2) Connect the test equipment as shown in figure 3-27.

(3) Tune the receiver to channel 200.

(4) Set the frequency of the signal generator to 300 MHz at an output level of –50 dbm.

(5) Set the receiver AC POWER switch to ON. The power meter should indicate between –20 dbm and –5 dbm.

(6) If the indication obtained in (5) above is outside specified limits, replace frequency mixer stage 2A1A2A2 as described in paragraph 3-60.

3-30. Frequency Multiplier 2A1A2A1

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM-98	Power meter
Attenuator, Fixed, 10 db, Microlab	10 db attenuator

Equipment	Common Name
AD-10MN Adapter-Connector UG-201A/U	
Cable Assembly, Special Purpose, Electrical	CMC 456-921
Cable Assembly, Radio Frequency	CMC 335-056

b. Operational Check.

(1) Disconnect plug P2 (2A1A2A3J3) (fig. 3–18) from connector J3 of bandpass filter assembly 2A1A2A3.

(2) Connect the test equipment as shown in figure 3–28.

(3) Set the AC POWER switch to ON and tune the receiver to channel 119. The output level at P2 (2A1A2A3J3) should be +7 dbm ±2 db, (power meter indication of –3 dbm ±2 db).

(4) Set the RCVR CHANNEL control to channel 120. The power meter indication should not change.

(5) Set the AC POWER switch to OFF. If the indications in (3) and (4) above are not within the specified limits replace the receiver RF head.

3–31. Control-Indicator 2A2

a. Test Equipment Required.

Equipment	Common name
Multimeter TS-352B/U	Multimeter
Cable Assembly, Special Purpose, Electrical	CMC 456-922

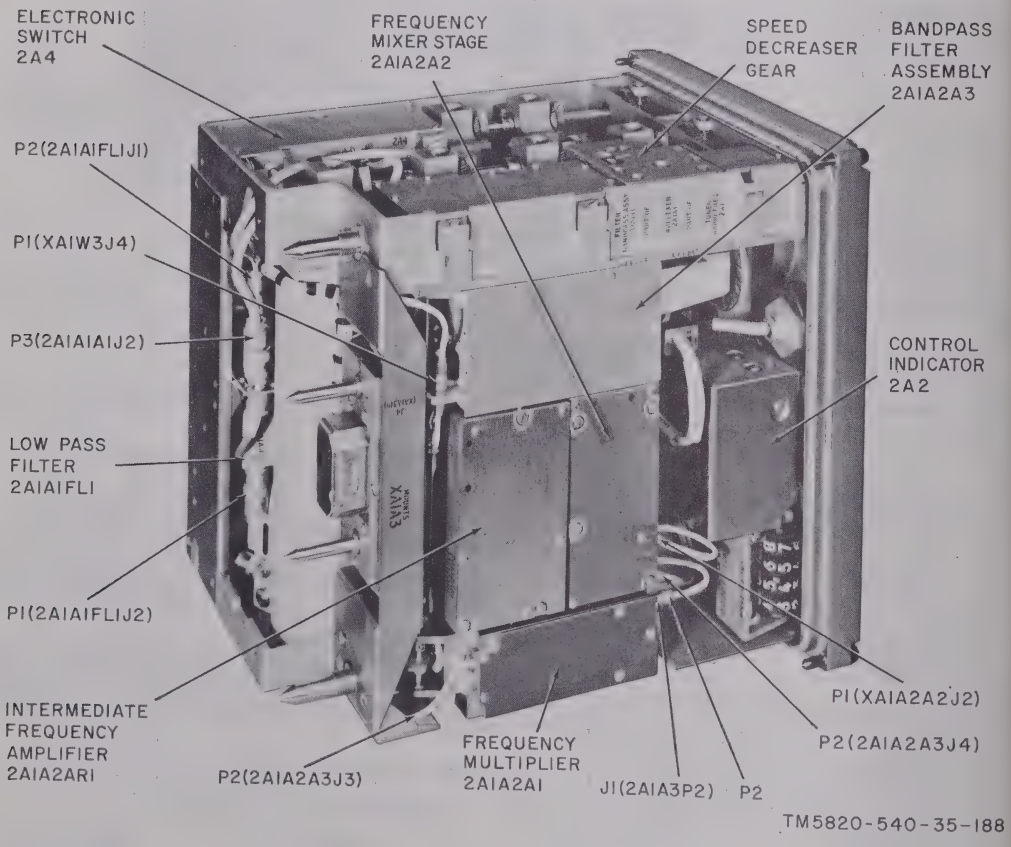


Figure 3-18. Receiver RF head, top and rear view.

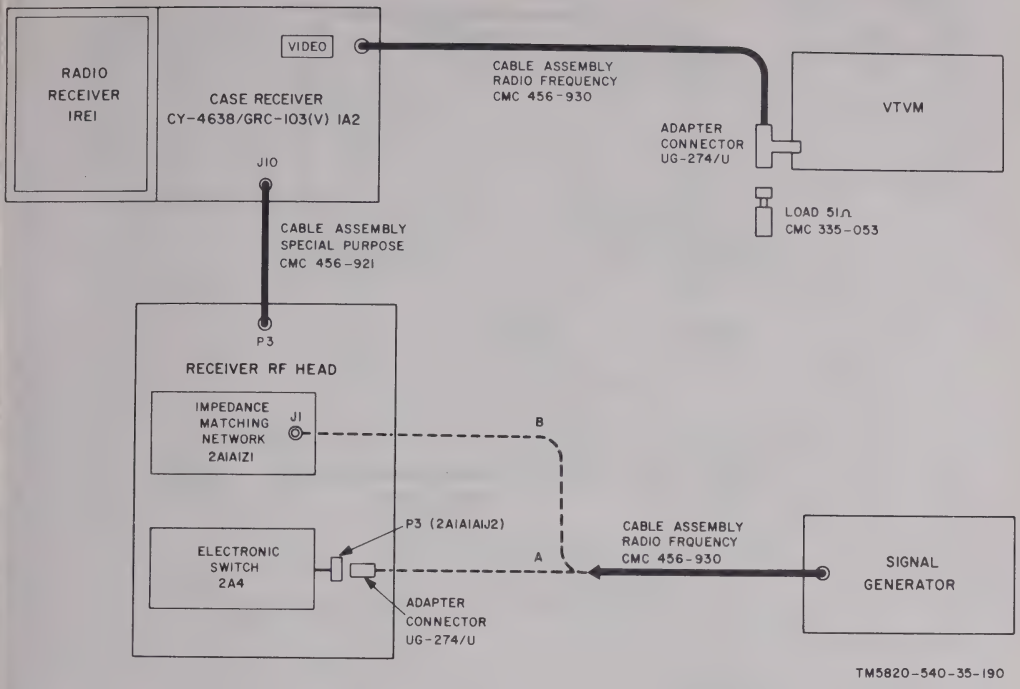


Figure 3-19. Duplexer bandpass filter (receive) operational check setup.

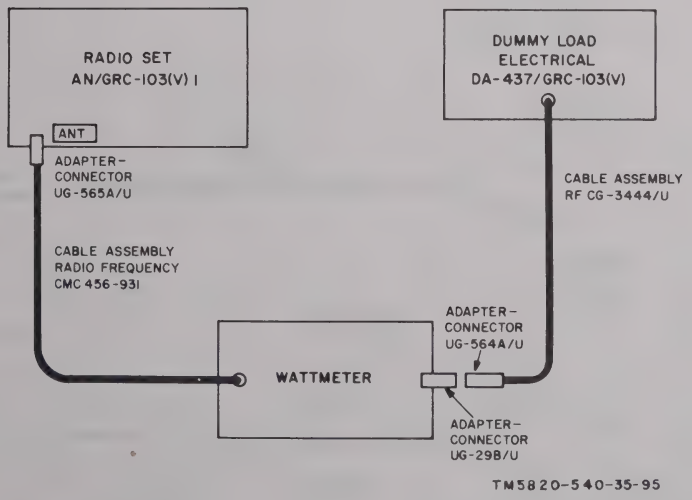


Figure 3-20. Power monitor 2A1A5 (transmit path) operational check setup.

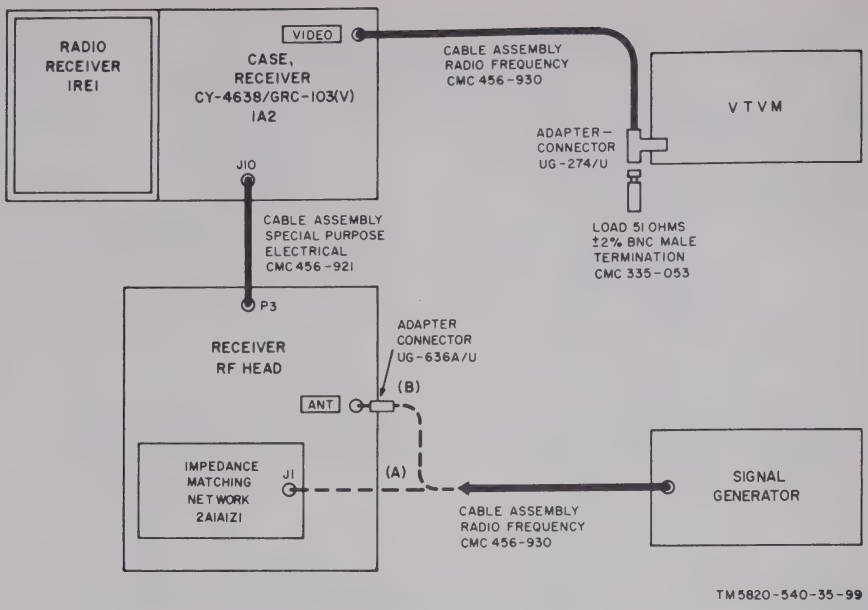


Figure 3-21. Power monitor 2A1A5 (receive path) operational check setup.

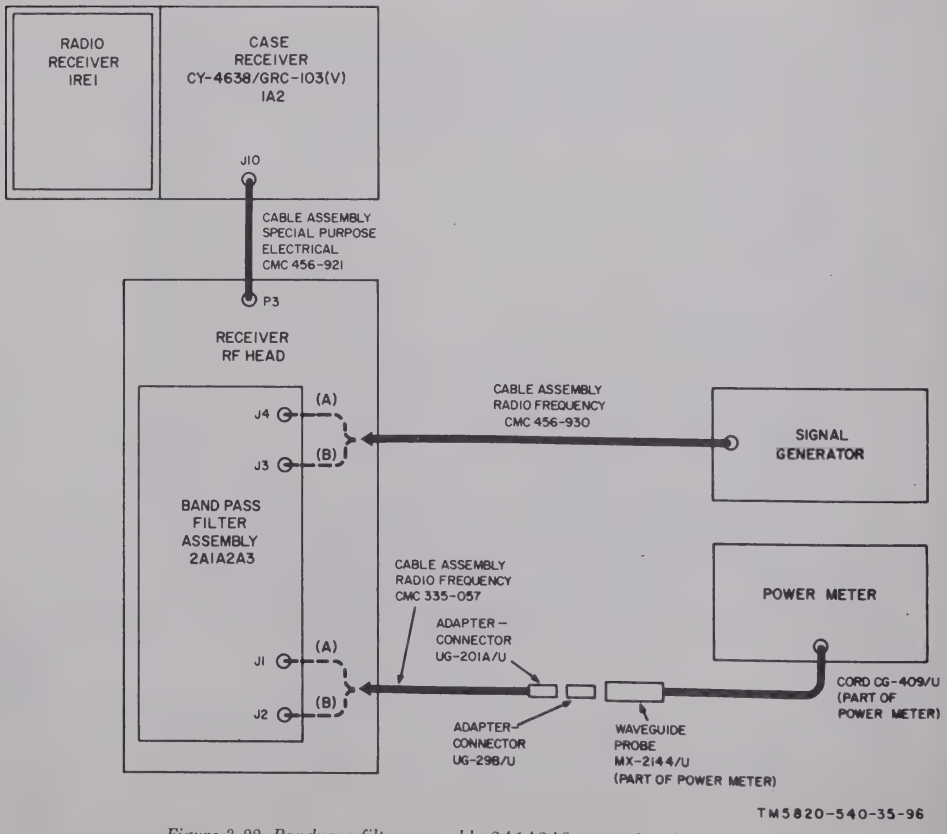


Figure 3-22. Bandpass filter assembly 2A1A2A3, operational check setup.

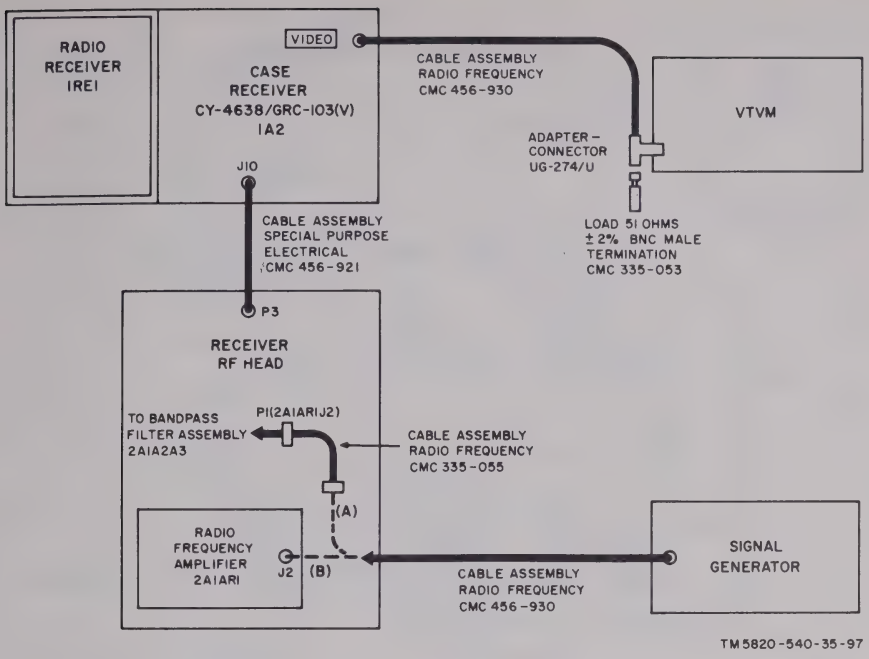


Figure 3-23. Radio frequency amplifier 2A1AR1, operational check setup.

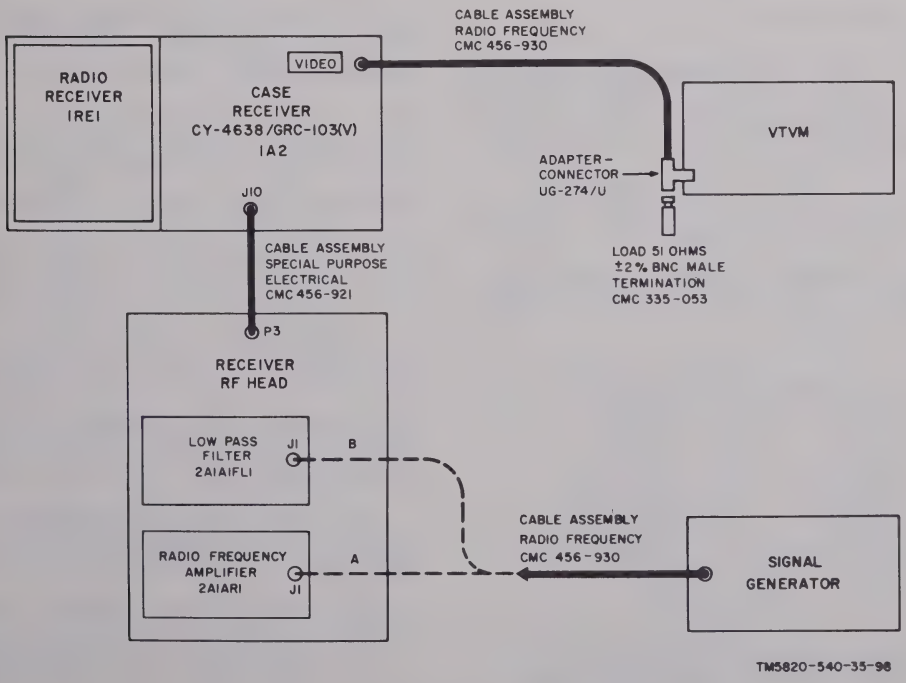


Figure 3-24. Low pass filter 2A1A1FL1, operational check setup.

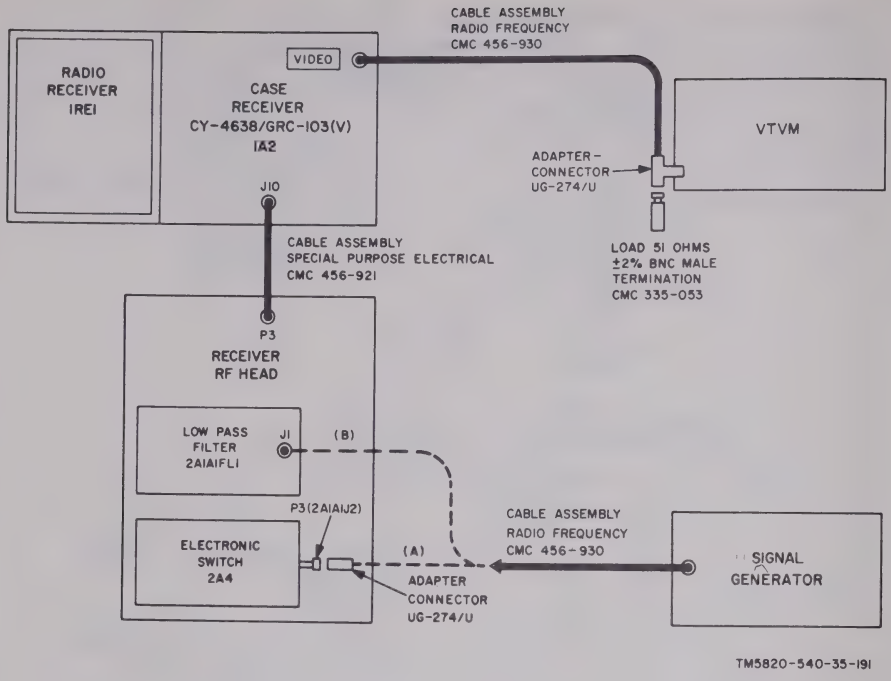


Figure 3-25. Electronic switch 2A4 and power supply 2PS1, operational check setup.

b. Operational Check.

(1) Loosen the two screws that secure plug P1 (2A1W4J4) to chassis connector 2A1W4J4 (fig. 3–16). Disconnect P1 (2A1W4J4) from 2A1W4J4.

(2) Set the RCVR CHANNEL control to channel 52.

(3) Using the multimeter, check between the following pins of P1 (2A1W4J4) as shown in the chart below.

Pins	Resistance
3 and 14	Infinity
4 and 14	Infinity
5 and 14	Infinity
6 and 14	Infinity
7 and 14	Infinity
8 and 14	Infinity
9 and 14	Infinity
10 and 14	Infinity
11 and 14	Infinity
12 and 14	Zero

(4) Set the RCVR CHANNEL control to channel 51.

(5) Using the multimeter, check between the following pins of P1 (2A1W4J4) as shown in the chart below.

Pins	Resistance
3 and 14	Zero
4 and 14	Zero
5 and 14	Zero
6 and 14	Zero
7 and 14	Zero
8 and 14	Zero
9 and 14	Zero
10 and 14	Zero
11 and 14	Zero
12 and 14	Infinity

(6) Remove control-indicator 2A2 from the receiver RF head, as described in chapter 6 of TM 11–5820–540–12.

(7) Connect plug P1 (2A1W4J4) to chassis connector 2A1W4J4 using the CMC 456–922 extender cable.

(8) Remove the four screws that secure the cover on control-indicator 2A2. Remove the cover.

(9) Set the receiver AC POWER switch to ON.

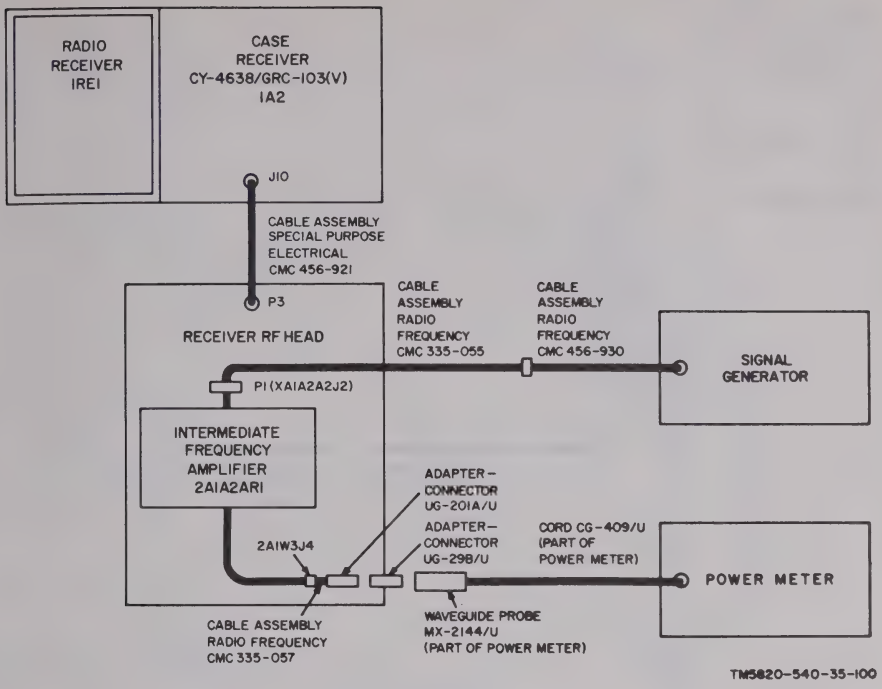


Figure 3-26. Intermediate frequency amplifier 2A1A2AR1, operational check setup.

(10) Set control-indicator 2A2 to channel 119.

(11) Using the multimeter, check the voltage at terminal E12 on command signal decoder 2A2A2. The multimeter should indicate 0 volt.

(12) Set control-indicator 2A2 to channel 120.

(13) Using the multimeter, check the voltage at terminal E12 on command signal decoder 2A2A2. The multimeter should indicate 10 volts.

(14) Set AC POWER switch to OFF. Reinstall control-indicator 2A2 cover. If abnormal indications are obtained in either (3), (5), (11), or (13) above, replace control-indicator 2A2. Refer to chapter 6 of TM 11-5820-540-12 for replacement procedures.

3-32. Power Supply 1RE1PS1

a. Test Equipment Required.

Equipment	Common name
Multimeter TS-352B/U	Multimeter
Cable Assembly Special Purpose, Electrical	CMC 456-922

b. Operational Check.

(1) Remove power supply 1RE1PS1 as described in chapter 6 of TM 11-5820-540-12.

(2) Connect connector P2 of 1RE1PS1 to receptacle 1RE1A1J1 of radio receiver 1RE1, using the CMC 456-922 extender cable.

(3) Set the receiver AC POWER switch to ON.

(4) Using the multimeter, measure the dc voltages at test points on voltage regulator amplifier 1RE1PS1AR1, as shown in the chart below.

Test point	Volts dc
TP5 (-) and TP6 (+)	+12 ±0.1
TP4 (-) and TP5 (+)	+12 ±0.1
TP4 (-) and TP6 (+)	+24 ±0.2

WARNING

Be extremely careful when working with the safety cover removed, 115 volts ac is exposed.

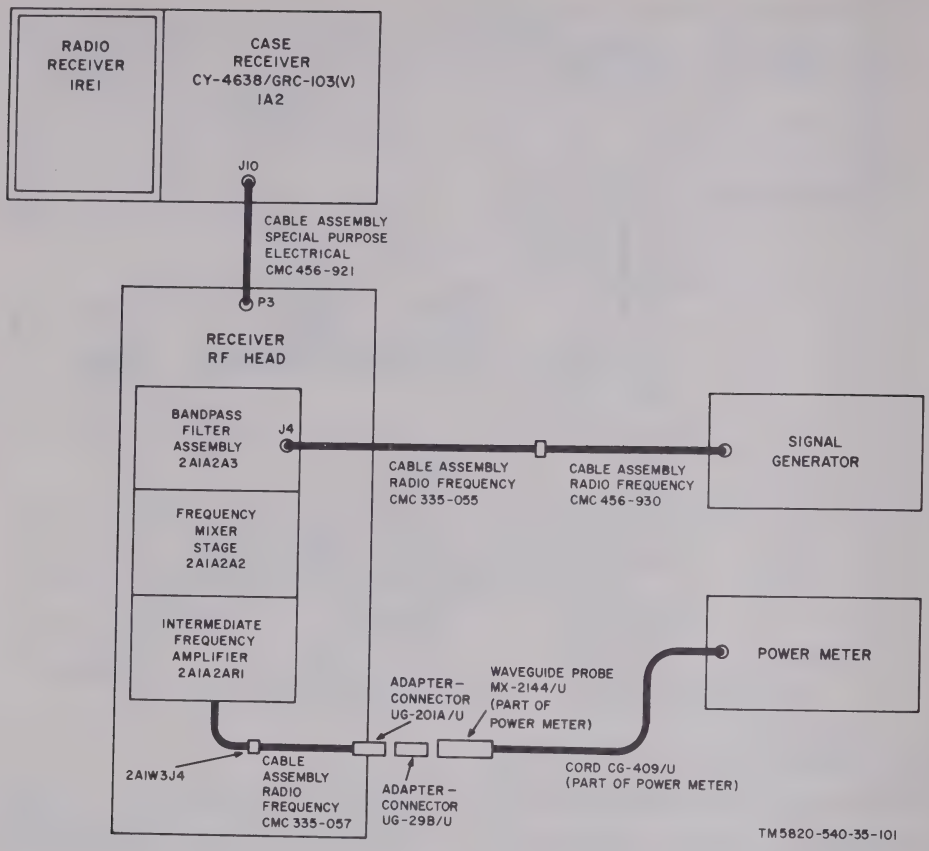


Figure 3-27. Frequency mixer stage 2A1A2A2, operational check setup.

(5) Carefully remove the small red safety cover marked DANGER 115V when cover removed. (fig. 3–29).

(6) Using the multimeter measure the dc voltage across filter connectors FL4 (–) and FL3 (+). A 26-volt dc indication should be obtained.

(7) Set the AC POWER switch to OFF. Reinstall the red safety cover. Replace power supply 1RE1PS1 if abnormal indications are obtained in either (4) or (6) above. Refer to chapter 6 of TM 11–5820–540–12 for replacement procedures.

3–33. Electrical Frequency Synthesizer 1RE1A2

NOTE

Troubleshooting electrical frequency synthesizer 1RE1A2 also involves checking control-indicator 2A2. If abnormal indications are obtained in any of the following tests, troubleshoot control-indicator 2A2 as described in paragraph 3–31 before replacing electrical frequency synthesizer 1RE1A2.

a. Test Equipment Required.

Equipment	Common Name
Wattmeter AN/URM-98	Power meter
Counter, Electronic Digital Readout AN/USM-207	Counter
Attenuator, Fixed, 10 db, AD-10MN	10 db attenuator
Load, 51 ohms	CMC 335-053
Adapter-Connector UG-201A/U (2 required)	
Adapter-Connector UG-29B/U	
Adapter-Connector UG-274/U	
Cable Assembly, Special Purpose, Electrical	CMC 456-919
Cable Assembly, Special Purpose, Electrical	CMC 456-920

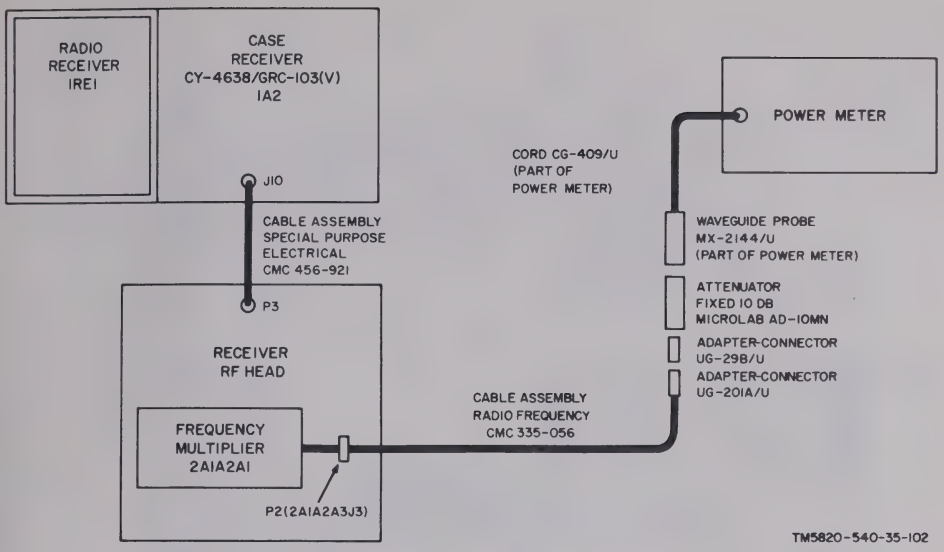


Figure 3-28. Frequency multiplier 2A1A2A1, operational check setup.

Equipment	Common Name
Cable Assembly, Special Purpose, Electrical	CMC 456-925
Cable Assembly, Radio Frequency	CMC 456-930
Cable Assembly, Radio Frequency	CMC 335-283

b. Test Setup.

(1) Remove electrical frequency synthesizer 1RE1A2 as described in paragraph 3–56.

(2) Remove amplifier-frequency multiplier 1RE1A5 from electrical frequency synthesizer 1RE1A2 as described in chapter 6 of TM 11–5820–540–12.

(3) Connect connector P2 of 1RE1A2 to receptacle 1RE1A1AJ3 of radio receiver 1RE1 using the CMC 456–925 extender cable as shown in figure 3–30.

c. Frequency Measurement.

(1) Connect the test equipment as shown in figure 3–30A.

(2) Set the receiver AC POWER switch to ON.

(3) Using the RCVR CHANNEL control on the receiver RF head, sequentially select the channels indicated in the chart below, and read the corresponding frequencies on the counter.

Channel	Frequency (MHz)	Tolerance (Hz)
40	62.500	±630.0
51	63.875	±630.0
52	64.000	±640.0
119	72.375	±720.0
120	48.333	±480.0
410	72.500	±720.0

d. Output Power Measurement.

(1) Disconnect the counter from the test setup used in *c* above.

(2) Connect the power meter probe to the 10 db attenuator as shown in figure 3–30B.

(3) Measure the power output at channels 119 and 120. Set the channels using the RCVR CHANNEL control. The power output indication on the power meter should be as shown in the chart below.

Channel	Power output
119	+12.0 dbm ±1 db
120	+16.0 dbm ±1 db

e. Conclusion of Operational Checks.

(1) Set the receiver AC POWER switch to OFF. Troubleshoot control indicator 2A2 as described in paragraph 3–31 if abnormal indications are obtained in either *c* or *d* above, to insure that electrical frequency synthesizer and not control-indicator 2A2 is defective.

(2) Reinstall amplifier-frequency multiplier 1RE1A5 on 1RE1A2, or on the 1RE1A2 replacement, as described in chapter 6 of TM 11–5820–540–12. Reinstall 1RE1A2 as described in paragraph 3–56.

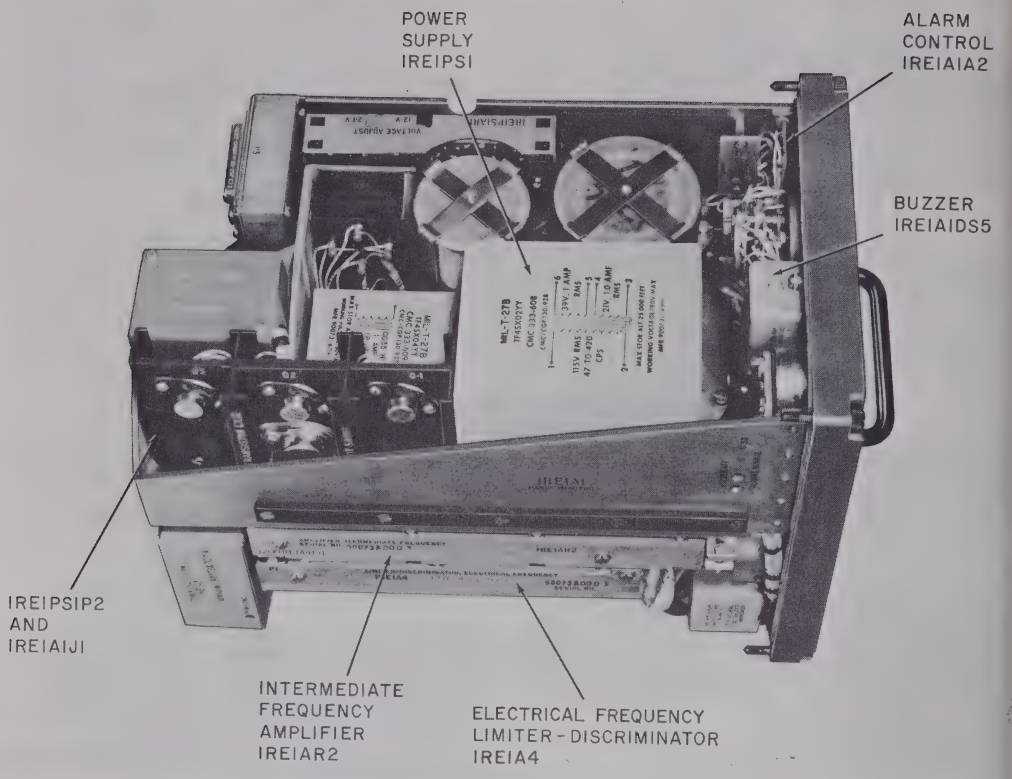


Figure 3-29. Radio receiver 1RE1, top view.

3–34. Amplifier-Frequency Multiplier 1RE1A5

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM-98	Power meter
Counter, Electronic Digital Readout AN/USM-207	Counter
Attenuator, Fixed, 10 db, Microlab AD-10MN	10 db attenuator
Load, 51 ohms	CMC 335-053
Adapter-Connector UG-201A/U (2 required)	
Adapter-Connector UG-29B/U	
Adapter-Connector UG-274/U	
Cable Assembly, Special Purpose, Electrical	CMC 456-921
Cable Assembly, Radio Frequency	CMC 335-056
Cable Assembly, Radio Frequency	CMC 456-930

b. Test Setup.

(1) Remove the receiver RF head from the receiver case and remove the dust cover as described in chapter 6 of TM 11–5820–540–12.

(2) Connect the receiver RF head to the receiver case, using the CMC 456–921, as shown in figure 3–31.

(3) Disconnect RF head plug P2 (XA1A2A1J1) (fig. 3–18) from connector J1 (2A1A3P2) on frequency multiplier 2A1A2A1.

c. Frequency Measurement.

(1) Connect the test equipment as shown in figure 3–31A.

(2) Set the receiver AC POWER switch to ON.

(3) Using the RCVR CHANNEL control on the receiver RF head, sequentially select the channels indicated in the chart below and read the corresponding frequencies on the counter.

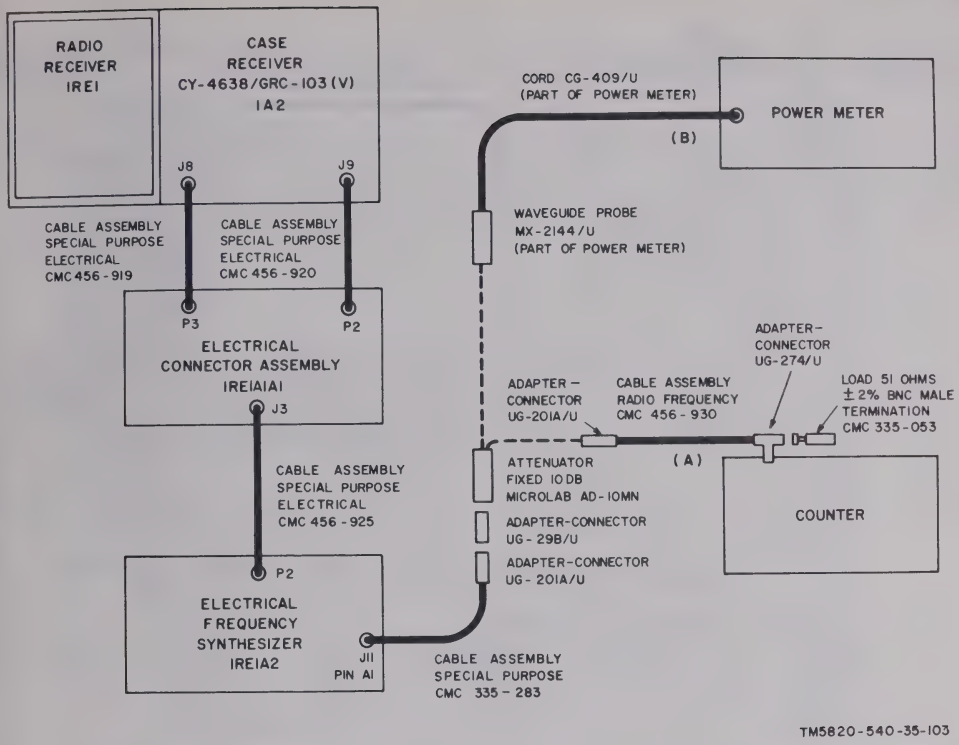


Figure 3-30. Electrical frequency synthesizer 1RE1A2, operational check setup.

Channel	Frequency (MHz)	Tolerance (Hz)
119	144.750	±2400.0
120	96.666	±2400.0

d. Output Power.

(1) Connect the test equipment as shown in figure 3-31B.

(2) Measure the power output at channels 119 and 120. Set the channels using the RCVR CHANNEL control. The power output indication on the power meter should be as shown in chart below.

Channel	Power output
119	+14 dbm ±1 db
120	+14 dbm ±1 db

e. Conclusion of Operational Checks. Set the receiver AC POWER switch to OFF. If abnormal indications are obtained in *c* and *d* above, replace amplifier-frequency multiplier 1RE1A5. Refer to chapter 6 of TM 11-5820-540-12 for replacement procedures.

3-35. Bandpass Filter 1RE1FL1

a. Test Equipment Required.

Equipment	Common name
Generator, Signal AN/USM-44A	Signal generator
Voltmeter, Electronic ME-30A/U	VTVM
Load, 51 ohms	CMC 456-053
Adapter-Connector UG-274/U	
Cable Assembly, Special Purpose, Electrical	CMC 456-919
Cable Assembly, Special Purpose, Electrical	CMC 456-920
Cable Assembly, Radio Frequency (2 required)	CMC 456-930
Cable Assembly, Radio Frequency	CMC 335-055
Cable Assembly, Radio Frequency	CMC 335-058

b. Operational Check.

(1) Disconnect plug P1 (1RE1FL1J2) (fig. 3-32) from connector J2 of bandpass filter 1RE1FL1.

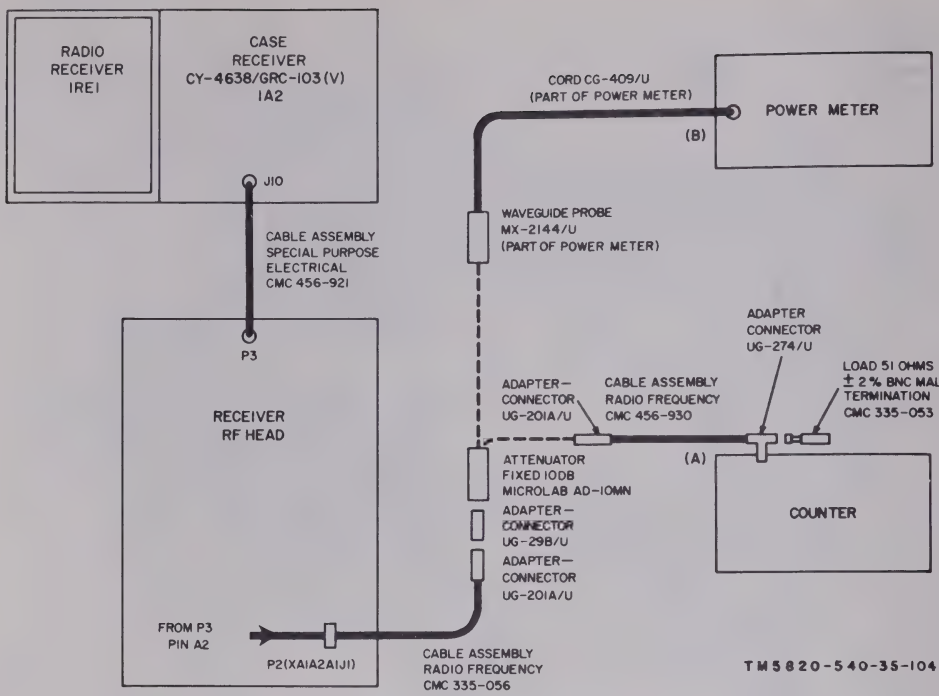


Figure 3-31. Amplifier-frequency multiplier 1RE1A5, operational check setup.

(2) Connect the test equipment as shown in figure 3–33A.

(3) Set the signal generator to 30 MHz.

(4) Set the receiver AC POWER switch to ON.

(5) Adjust the output of the signal generator until the VTVM indicates approximately –50 dbm.

(6) Adjust the frequency of the signal generator slightly for minimum indication on the VTVM, and readjust the output level of the signal generator again for a reading of –50 dbm on the VTVM.

(7) Note the attenuator setting on the signal generator.

(8) Disconnect plug P2 (1RE1FL1J1) from connector J1 of 1RE1FL1.

(9) Connect the test equipment as shown in figure 3–33B.

(10) Repeat (6) above.

(11) The attenuator setting on the signal generator should not be more than 12 db below the level noted in (7) above.

(12) Set the AC POWER switch to OFF. If the indication obtained in (11) above is not within the specified limit, replace bandpass filter 1RE1FL1. Refer to chapter 6 of TM 11–5820–540–12, for replacement procedures.

3–36. Intermediate Frequency Amplifier 1RE1AR2

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM-98	Power meter
Generator, Signal AN/USM-44A	Signal generator
Adapter-Connector UG-636A/U	
Adapter-Connector UG-29B/U	
Adapter-Connector UG-201A/U	
Cable Assembly, Special Purpose, Electrical	CMC 456-919
Cable Assembly, Special Purpose, Electrical	CMC 456-920
Cable Assembly, Radio Frequency	CMC 456-930
Cable Assembly, Radio Frequency	CMC 217-800-000-000

b. Operational Check.

(1) Remove electrical frequency limiter-discriminator 1RE1A4 as described in TM 11–5820

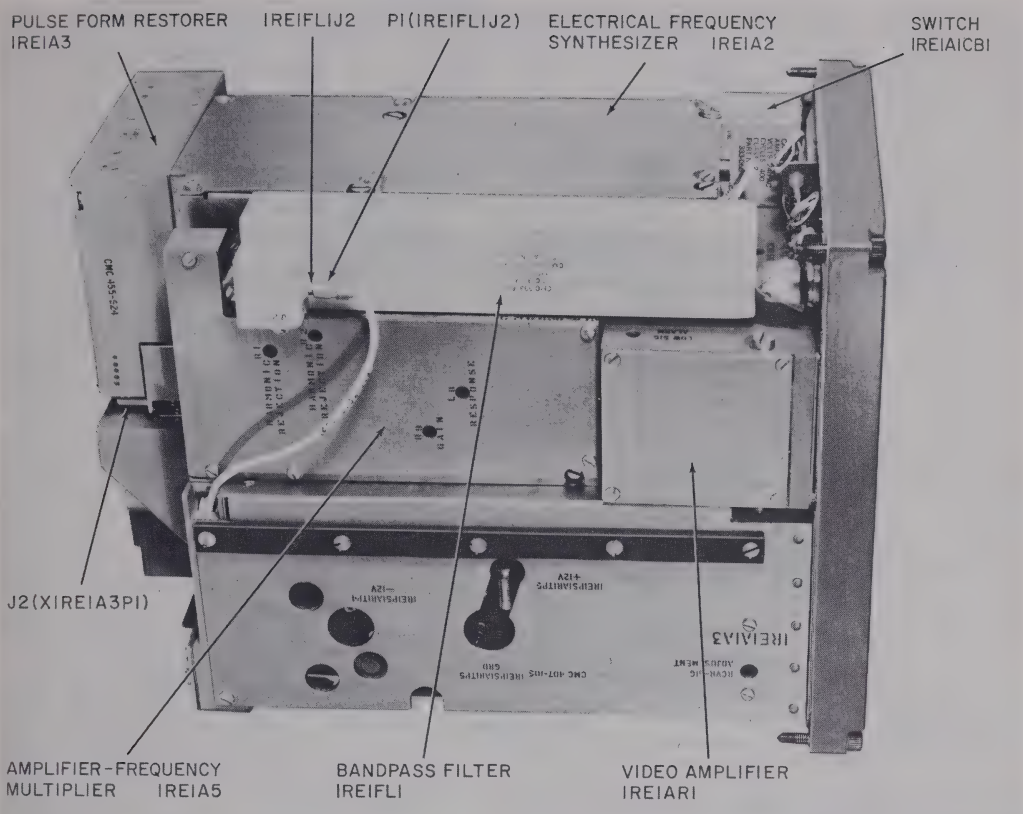


Figure 3-32. Radio receiver 1RE1, bottom and side view.

540–12 and connect it to intermediate frequency amplifier 1RE1AR2 using the CMC 217–800–000–000 extender cable.

(2) Connect the test equipment as shown in Figure 3–34.

(3) Set the signal generator to 300 MHZ at a level of –74 dbm.

(4) Set the receiver AC POWER switch to ON.

(5) Tune the receiver to channel 200. The power meter should indicate between –1.5 dbm and –4.5 dbm.

(6) If the indication in (5) above is outside the specified limits, replace intermediate frequency amplifier 1RE1AR2 as described in chapter 6 of TM 11–5820–540–12.

3–37. Electrical Frequency Limiter-Discriminator 1RE1A4

a. Test Equipment Required.

Equipment	Common name
Generator, Signal AN/USM-205	Wide range oscillator
Oscilloscope AN/USM-140	Oscilloscope
Converter, Frequency, Electronic CV-2500/GRC	Loop test set
Dummy Load, Electrical DA-437/GRC-103(V)	Dummy load
Adapter-Connector UG-274/U	
Cable Assembly, Radio Frequency (2 required)	CMC 456-930
Cable Assembly, Special Purpose, Electrical	CMC 456-919

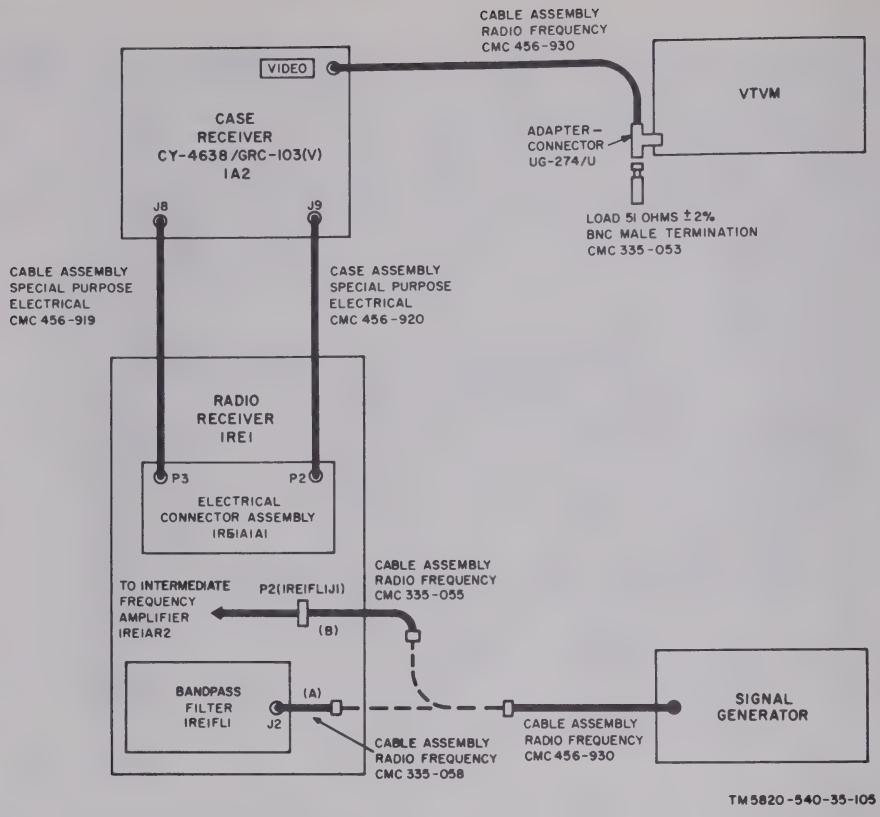


Figure 3-33. Bandpass filter 1RE1FL1, operational check setup.

Equipment	Common Name
Cable Assembly, Special Purpose, Electrical	CMC 456-920

b. Operating Procedure.

(1) Remove the six screws that secure the bottom cover plate to the case of electrical frequency limiter-discriminator 1RE1A4. Remove the cover plate.

(2) Set up the loop test as described in paragraph 3–4, connecting the test equipment as shown in figure 3–35A.

(3) Set the frequency of the wide range oscillator to 10 kHz and adjust the amplitude of the output signal to 2 volts peak-to-peak as measured on the oscilloscope. Disconnect the oscilloscope from the wide range oscillator, and connect the oscilloscope probe to 1RE1A4E1 as shown in figure 3–35B.

(4) Proceed with the loop test procedure as described in paragraph 3–4.

NOTE

Set the transmitter INPUT control for 50 percent of full scale meter deflection, with the transmitter meter switch in the 24 CH PCM position.

(5) Using the oscilloscope, measure the voltage between ground and terminal E1 at the electrical frequency limiter-discriminator 1RE1-A4 output. The oscilloscope should indicate between 250 and 400 millivolts peak-to-peak.

(7) If the indication in (6) above is outside the specified limits, replace electrical frequency limiter-discriminator 1RE1A4. Refer to TM 11–5820–540–12 for replacement procedures.

3–38. Video Amplifier 1RE1AR1

a. Test Equipment Required.

Equipment	Common name
Generator, Signal AN/USM-205	Wide range oscillator
Oscilloscope AN/USM-140	Oscilloscope

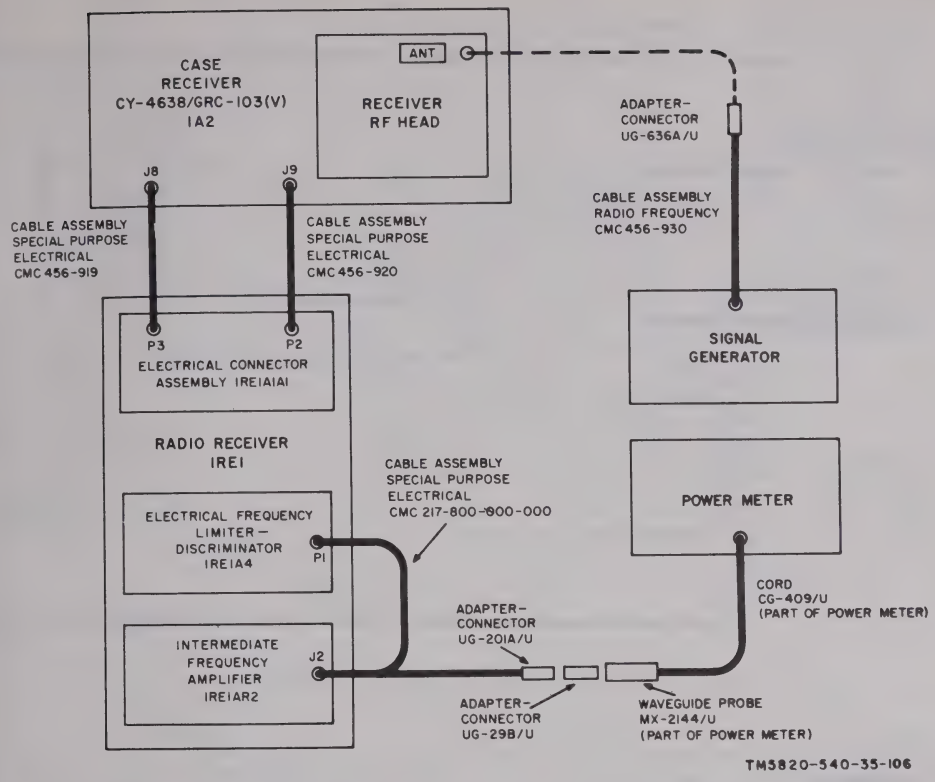


Figure 3-34. Intermediate frequency amplifier 1RE1AR2, operational check setup.

Equipment	Common Name
Adapter-Connector UG-274/U (2 required)	
Cable Assembly, Radio Frequency (2 required)	CMC 456-930
Cable Assembly, Radio Frequency	CMC 335-283
Cable Assembly, Special Purpose, Electrical	CMC 456-919
Cable Assembly, Special Purpose, Electrical (2 required)	CMC 456-920

b. Operational Check.

(1) Remove pulse form restorer 1RE1A3 rom radio receiver 1RE1 as described in chapter of TM 11–5820–540–12.

(2) Connect the test equipment as shown in igure 3–3.

(3) Set the frequency of the wide range os-illator to 10 kHz and adjust the amplitude of he output signal to 106 millivolt rms as meas-ured on the VTVM.

(4) Using the oscilloscope probe, measure the open circuit voltage between pin 7 of J2 (X1RE1A3P1) and ground (fig. 3–32). The oscilloscope should display a 5.6-volt peak-to-peak undistorted 10-kHz sinewave.

(5) If an abnormal display is obtained in (5) above, check continuity between pin 7 of J2 (X1RE1A3P1) and J2 (X1RE1AR1P1) (fig. 6–29).

(6) If the wiring is normal, replace video amplifier 1RE1AR1. Refer to chapter 6 of TM 11–5820–540–12 for replacement procedures.

3–39. Pulse Form Restorer 1RE1A3

a. Test Equipment Required.

Equipment	Common name
Generator, Signal AN/USM-205	Wide range oscillator
Oscilloscope AN/USM-140	Oscilloscope
Converter, Frequency, Electronic CV-2500( )/GRC	Loop test set
Dummy Load, Electrical DA-437/GRC-103(V)	Dummy load

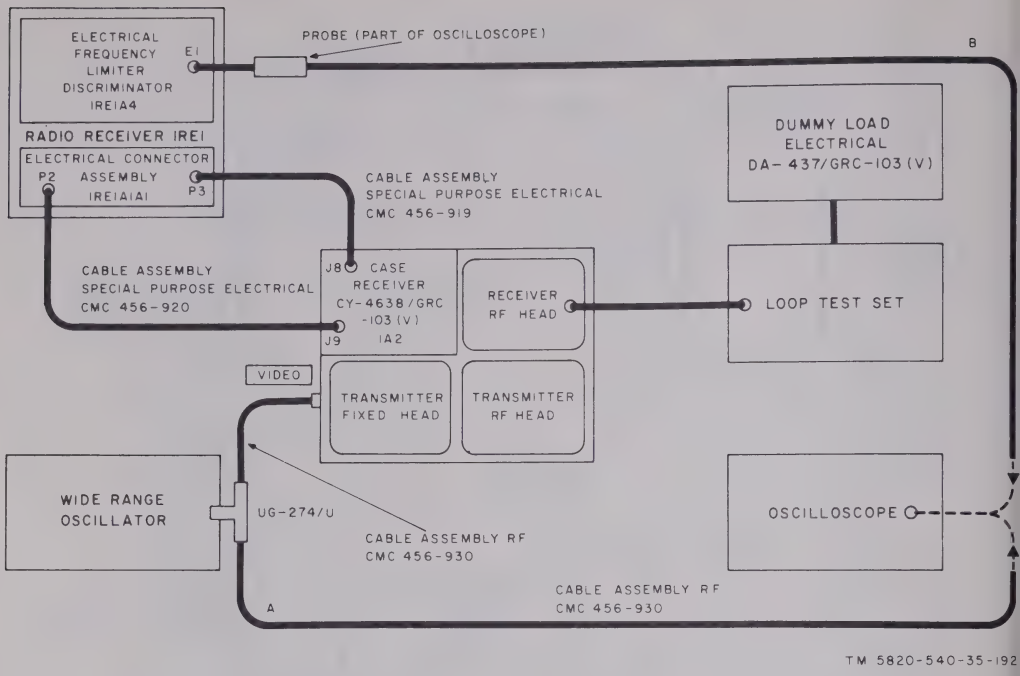


Figure 3-35. Electrical frequency limiter-discriminator 1RE1A4, operational check setup.

Equipment	Common name
Load, 91 ohms	CMC 335-052
Adapter-Connector UG-274/U (2 required)	
Cable Assembly, Radio Frequency (2 required)	CMC 456-930
Cable Assembly, Special Purpose, Electrical	CMC 456-919
Cable Assembly, Special Purpose, Electrical (2 required)	CMC 456-920

b. Operational Check.

(1) Remove pulse from restorer 1RE1A3 from radio receiver 1RE1, as described in chapter 6 of TM 11-5820-540-12.

(2) Connect the test equipment as shown in figure 3-37.

(3) Remove the cover plate of pulse form restorer 1RE1A3, secured to the unit case with four countersunk screws.

(4) Remove the four screws that secure pulse form restorer 1RE1A3A2 board to the unit case. Carefully pull the board away from the case until terminals E2 and E7 are accessible.

(5) Proceed with the loop test procedure as described in chapter 6 of TM 11-5820-540-12.

NOTE

Set the transmitter INPUT control for 50 percent of full scale meter deflection with the transmitter meter switch in the 12 CH PCM position.

(6) Connect the oscilloscope test lead b tween terminal E2 on pulse form restor 1RE1A3A2 board and ground. A 2-volt peak-t peak square wave should be displayed on t oscilloscope.

(7) Connect the oscilloscope test lead b tween terminal E7 on the pulse form restor 1RE1A3A2 board and ground. A 2-volt pea to-peak positive-going timing spike should be di played on the oscilloscope (fig. 3-38).

(10) If abnormal indications are obtained (6) or (7) above, replace pulse form restor 1RE1A3. Refer to chapter 6 of TM 11-5820-54 12 for replacement procedures.

3-40. Order Wire Unit

NOTE

The complete radio set is required to troubleshoot the order wire unit boards. Extend amplifier assembly 9A4 and telephone signal converter 9A3 boards using two CMC 456-929 cables (fig. 3-39).

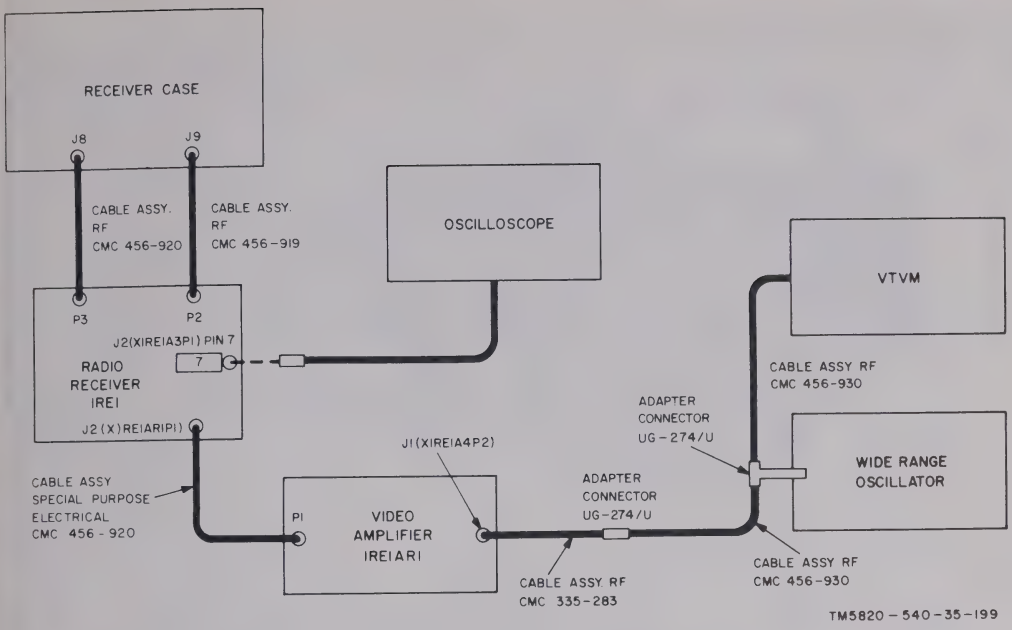


Figure 3-36. Video amplifier 1RE1AR1, operational setup.

a. Test Equipment Required.

Equipment	Common name
Voltmeter, Electronic ME-30A/U	VTVM
Converter, Frequency, Electronic CV-2500( )/GRC	Loop test set
Dummy Load, Electrical DA-437/GRC-103(V)	Dummy load
Cable Assembly, Special Purpose, Electrical	CMC 456-929

a. Operational Check.

(1) Set up the loop test as described in chapter 6 of TM 11-5820-540-12.

NOTE

It is not necessary to connect multiplex equipment to the radio set.

(2) Proceed with the loop test procedures described in chapter 6 of TM 11-5820-540-12.

(3) Press order wire unit RING button (fig. 3-40).

(4) Using the VTVM, measure the power at test point TP4 on amplifier assembly 9A4. The VTVM should indicate -7.2 dbm ±0.5 db.

(5) If the indication obtained in (4) above is outside the specified limits, replace telephone signal converter 9A3.

(6) Press the RING button.

(7) Using the VTVM measure the power at the amplifier assembly 9A4 test points as shown in the chart below.

Test point	Power
TP1 to TP2	-10 dbm ±0.5 db
TP9 to TP2	-10 dbm ±0.5 db
TP7 to TP2	-24 dbm ±1.0 db

(8) Disconnect Cable Assembly, Special Purpose, Electrical, Branched CX-10763/GRC-103(V) from the TO RADIO connector of the order wire unit and connect it to the PATCH THRU connector.

(9) Press RING button.

(10) Using the VTVM, measure the power at the amplifier assembly 9A4 test points as shown in the chart below.

Test point	Power
TP3 to TP2	-10 dbm ±0.5 db
TP10 to TP2	-10 dbm ±0.5 db
TP7 to TP2	-24 dbm ±1.0 db

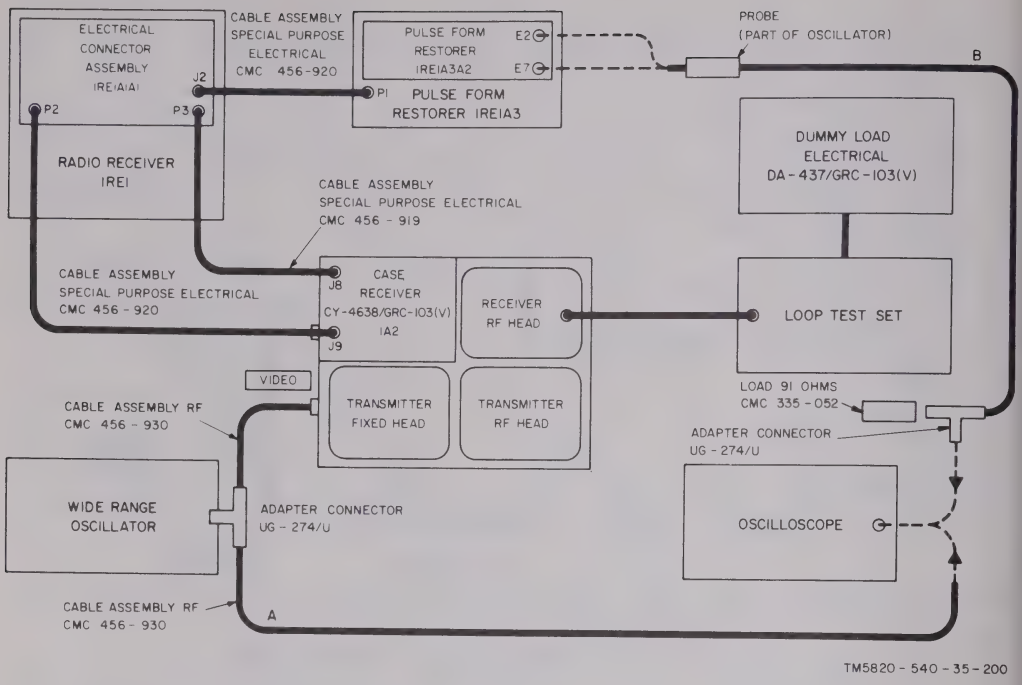


Figure 3-37. Pulse form restorer 1RE1A3, operational setup.

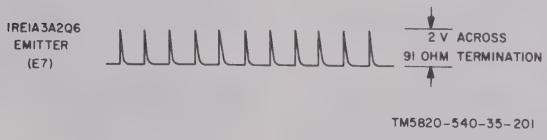


Figure 3-38. Pulse form restorer 1RE1A3 timing pulses.

(11) If abnormal indications are obtained in (10) above, replace amplifier assembly 9A4.

(12) Press the RING button.

(13) Using the VTVM, measure the voltage at TP2 of telephone signal converter 9A3. Th indication should be 1.6 volt ±0.1 volt rms.

(14) If an abnormal indication is obtaine in (13) above, replace telephone signal converte 9A3.

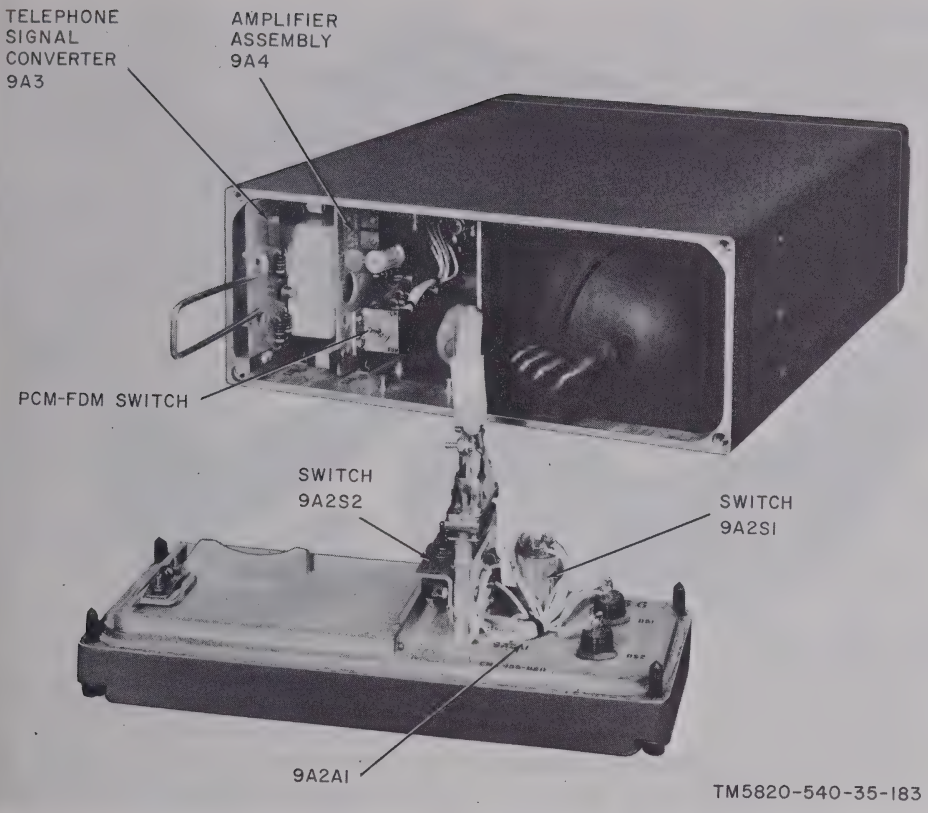


Figure 3-39. Order wire unit, monitor panel 9A2.

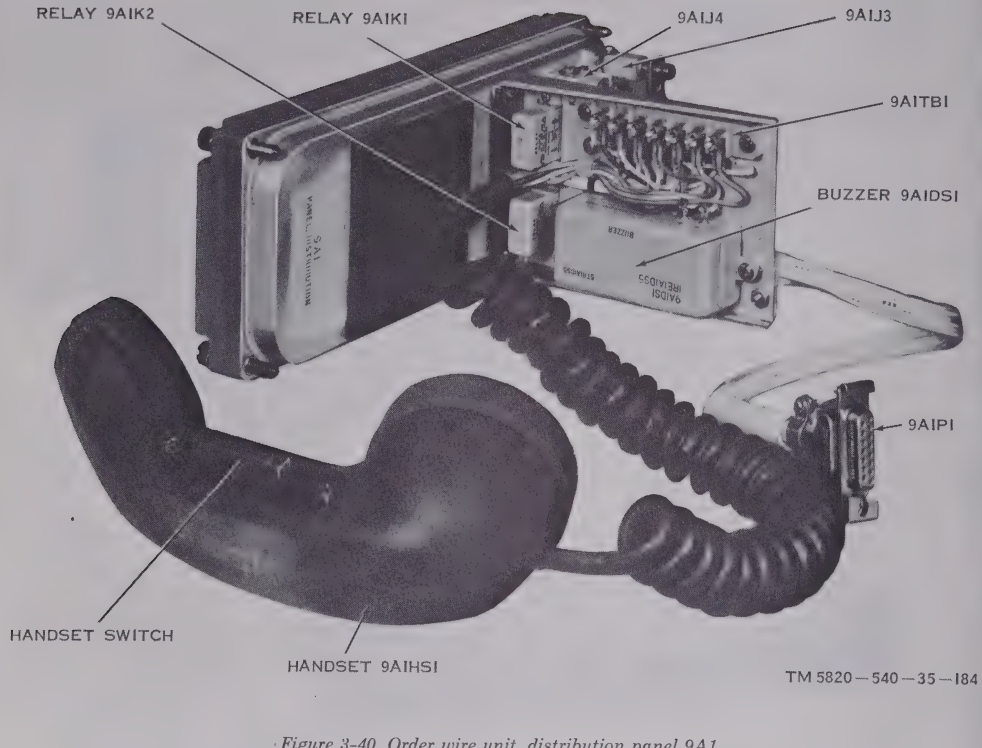


Figure 3-40. Order wire unit, distribution panel 9A1.

Section III. MODULE REMOVAL AND REPLACEMENT PROCEDURES

3–41. General

When trouble has been localized to a module of the radio set, replace the defective part as described in paragraphs 3–43 to 3–63. Before installing a replacement module, always check connectors for bent or damaged pins. Do not tighten the module mounting screws to press home connectors. Whenever difficulty is encountered in mating connectors, remove the module and inspect the connectors for damage.

3–42. Equipment Required

The following equipment is required for the replacement of power monitor 6AR1A3, frequency multiplier assembly 6A2, and power monitor 2A1A5.

Description	Manufacturer's number	Qty.
Socket wrench 7/8-inch		1
Cable Assembly, Special Purpose, Electrical.	CMC 456-918	1

3–43. General Module Replacement Procedures

a. Transmitter, Radio T–983(P)/GRC–103 (V) Modules. To replace a module of this unit first remove radio transmitter 5TR1 from the transmitter case as described in chapter 6 of TM 11–5820–540–12. To replace centrifugal fan 5A2B1, the transmitter RF head must also be removed from the transmitter case, as described in chapter 6 of TM 11–5820–540–12.

b. Amplifier-Frequency Multiplier AM–4320/GRC–103(V) Modules. To replace a module of this unit, first remove the transmitter rf head from the transmitter case, as described in chapter 6 of TM 11–5820–540–12, then remove the transmitter RF head dust cover, which is secured to the unit with nine screws. Reinstall the dust cover after replacing the faulty module.

c. Receiver, Radio R–1329(P)/GRC–103(V) Modules. To replace a module of this unit, first remove radio receiver 1RE1 from the receiver case as described in chapter 6 of TM 11–5820–540–12.

d. Amplifier-Converter AM–4316/GRC–103) Modules. To replace a module of this unit, 'st remove the receiver RF head from the re- iver case, as described in chapter 6 of TM 11– 20–540–12, then remove the receiver RF head st cover, which is secured to the unit with elve screws and two hexagonal nuts on the lo- ting pins. Reinstall the dust cover after replac- g the faulty module.

e. Receiver-Transmitter, Order Wire RT–773/ RC–103(V) Modules. Replacement of tele- one signal converter 9A3 and amplifier assem- y 9A4 is covered in chapter 6 of TM 11– 20–540–12.

-44. Replacement of Amplifier-Monitor 5TR1A5, Alarm Control 5TR1A3 and Centrifugal Fan 5A2B1

eplacement of these modules is described in apter 6 of TM 11–5820–540–12.

-45. Replacement of Electrical Frequency Synthesizer 5TR1A2

a. Place radio transmitter 5TR1 bottom side) and locate 5TR1A2 (fig. 3–3).

b. Loosen the four green-circled screws and t 5TR1A2, together with amplifier-monitor R1A5 and amplifier-frequency multiplier R1A4, straight up from the chassis to disen- ge the connectors. If the connectors do not sep- ate easily, pry the chassis and modules apart ith a screwdriver but do not touch the mating nnectors.

c. Locate and loosen the two green-circled ounting screws that secure amplifier-monitor R1A5 to 5TR1A2 and remove the module.

d. Loosen the two green-circled mounting rews that secure amplifier-frequency multiplier R1A4 to 5TR1A2 and pull straight away to dis- gage the connectors.

e. To install the 5TR1A2 replacement module, rst mount and secure 5TR1A4 on 5TR1A2. Then ace 5TR1A2 in position over its chassis con- ctor and press down to engage the connector. ghten the four mounting screws.

f. Reinstall amplifier-monitor 5TR1A5, as de- ribed in chapter 6 of TM 11–5820–540–12.

-46. Replacement of Amplifier-Frequency Multiplier 5TR1A4

a. Replacement of 5TR1A4 is a second-order noval. Electrical frequency synthesizer 5TR1A2 ust be removed first, as described in paragraph 45.

b. Loosen the two green-circled mounting screws that secure 5TR1A4 to 5TR1A2; pull 5TR1A4 straight away from 5TR1A2 to disengage the connectors.

c. To install the 5TR1A4 replacement module, place the module in position against 5TR1A2, then press in until the connectors are fully engaged. The holes for the mounting screws are not properly aligned unless the connectors are fully engaged.

d. Tighten the two mounting screws.

e. Reinstall 5TR1A2 with its attached modules, as described in paragraph 3–45.

3–47. Replacement of Power Supply 5TR1PS1

a. Replacement of 5TR1PS1 is a second-order removal. Electrical frequency synthesizer 5TR–1A2 must be removed first as described in paragraph 3–45.

b. Locate and loosen the eight green-circled screws that secure 5TR1PS1 to the chassis. Place radio transmitter 5TR1 upright and lift 5TR1PS1 straight up from the chassis until the large multipin connector is disengaged.

c. To install the 5TR1PS1 replacement module, place it in position above the chassis then press straight down until the connector is fully engaged. Turn radio transmitter 5TR1 on its left or right side and tighten the eight mounting screws securing 5TR1PS1 to the chassis.

d. Place radio transmitter 5TR1 bottom side up and reinstall 5TR1A2 with its attached modules, as described in paragraph 3–45.

3–48. Replacement of Alarm Control 5TR1A1A2

a. Place radio transmitter 5TR1 bottom side up and locate alarm control 5TR1A1A2 (fig. 3–3).

b. Locate electrical frequency synthesizer 5TR–1A2 and remove it, with associated modules, as described in paragraph 3–45.

c. Unsolder, and identify with tags, the wires at terminals E1 through E14 and E17.

d. Loosen the two mounting screws and remove the 5TR1A1A2 board.

e. Install the new 5TR1A1A2 board and tighten the two mounting screws.

f. Reconnect and resolder the wires removed in *c* above.

g. Reinstall 5TR1A2, with its attached modules, as described in paragraph 3–45.

3–49. Replacement of Buzzer 5TR1A1DS5

a. Place radio transmitter 5TR1 bottom side up and locate buzzer 5TR1A1DS5 (fig. 3–3).

b. Locate electrical frequency synthesizer 5TR–1A2 and remove it, with associated modules, as described in paragraph 3–45.

c. Unsolder the two wires from the 5TR1A1DS5 terminals; note the polarity and tag the leads. Loosen the two green-circled screws and remove 5TR1A1DS5.

d. To install the 5TR1A1DS5 replacement module, position the module over the two mounting holes and tighten the mounting screws. Resolder the two wire leads to their appropriate terminals.

e. Reinstall 5TR1A2 with its attached modules as described in paragraph 3–45.

3–50. Replacements of Electronic Switch 6A1 and Control-Indicator 6A3

Replacement of electronic switch 6A1 and control-indicator 6A3 is covered in chapter 6 of TM 11–5820–540–12.

3–51. Replacement of Low Pass Filter 6AR1A2FL1

a. Place the transmitter RF head top side up and locate low-pass filter 6AR1A2FL1 on the right-hand side.

b. Disconnect the two RF leads, P1 (6AR1A1–J2) and P2 (XAR1A3J1), from their respective mating connectors.

c. Loosen the two green-circled mounting screws that secure 6AR1A2FL1 to the chassis. Remove 6AR1A2FL1.

d. To install the 6AR1A2FL1 replacement module, position the module over the two mounting holes and tighten the mounting screws. Connect plugs P1 (6AR1A1J2) and P2 (XAR1A3–J1), at the ends of RF leads, to mating connectors J2 of amplifier subassembly 6AR1A1 and J1 of power monitor 6AR1A3 respectively.

3–52. Replacement of Power Monitor 6AR1A3

a. Place the transmitter RF head top side up and locate power monitor 6AR1A3 at the top right side.

b. On the front panel of the transmitter rf head, loosen and remove the hexagonal nut that secures the PWR OUT connector to the front panel.

c. Loosen the two screws that secure plug P1 (XW1J3) to its connector. Disconnect the P2 (XAR1A3J1) lead from connector J1 of 6AR1A3 (fig. 3–13).

d. Remove the four screws that secure powe monitor 6AR1A3 to its bracket and remove th module.

e. To install the AR1A3 replacement, slide con nector J2 of the power monitor into the PWI OUT opening in the front panel and secure wit the hexagonal nut. Secure AR1A3 to its mountin bracket with four screws.

NOTE

The PWR OUT connector must be well secured before tightening the 6AR1A3 mounting screws.

f. Connect the P2 (XAR1A3J1) RF lead t connector J1 of 6AR1A3. Connect plug P (XW1J3) to connector 6W1J3 on the chassis an secure with two screws.

3–53. Replacement of Frequency Multiplier Assembly 6A2

NOTE

Replacement of frequency multiplier assembly 6A2 requires electromechanical alignment and should not be attempted unless absolutely necessary.

a. Equipment Required.

Equipment	Common name
Dummy Load, Electrical DA-437/GRC-103(V)	Dummy load
Cable Assembly, RF CG-3444/U (1 ft 6 in.)	
Cable Assembly, Special Purpose, Electrical	CMC 456-918

b. Set the transmitter RF head XMTR TUN and XMTR CHANNEL controls to channel 3.

c. Set the transmitter RF head top side and locate frequency multiplier assembly 6 (fig. 3–6). Locate electronic switch 6A1 and d connect the rf leads from the J1, J2, J3, J4, a J6 connectors. Disconnect the RF lead from 6W2J1 chassis connector (from RF power le control 6A5). Disconnect the RF lead from J2 connector of RF power level control 6A5.

d. Loosen the four red-circled screws that cure frequency multiplier assembly 6A2 to chassis. Slide 6A2 away from the front panel disengage the flexible drive shaft. Remove module from the transmitter RF head.

e. Loosen the two green-circled screws that cure RF power level control 6A5 to freque multiplier assembly 6A2. Remove the 6A5 m ule.

f. To install the 6A2 replacement module, first ecure rf power level control 6A5 to frequency ultiplier assembly 6A2 replacement with the two crews provided.

g. Set the transmitter rf head XMTR TUNE nd XMTR CHANNEL controls to channel 340.

NOTE

The 6A2 replacement module is shipped with its shaft clamped to channel 340. Remove the throwaway clamp carefully to avoid disturbing the shaft position.

h. Lower the 6A2 replacement module into po- tion on the chassis but do not connect it to the exible drive shaft. Connect the RF leads to elec- onic switch 6A1 as shown in the chart below.

RF lead	Connects to 6A1 connector
P4(XA1J1)	J1
P3(XA1J2)	J2
P2(XA1J3)	J3
P1(XA1J4)	J4

i. Connect the P1 (XA1J6) and P2 (6W2J1) F leads of 6A5 to connector J6 of 6A1 and to assis connector 6W2J1 respectively. Connect P1 5A5J2) RF lead to connector J2 of 6A5.

j. Connect the dummy load to the PWR OUT nnector of the transmitter rf head using Cable ssembly, RF CG–3444/U (1 ft 6 in.). Connect ble CMC 456–918 between the transmitter case nd the transmitter JF head.

WARNING

Do not touch the exposed filter-connectors on connector filter assembly 6AR1A2A3. Dangerous voltages exist at these filter-connectors.

k. Set the transmitter meter switch to the ULT position and the AC POWER switch to N/RESET.

l. Carefully rotate the shaft of frequency mul- plier assembly 6A2 until a maximum indication obtained on the transmitter meter. It should not e necessary to rotate the shaft more than 90 egrees from its original position.

m. Set the transmitter meter switch to the RIVER and PWR OUT positions in turn, and heck to see that the meter indicates between 25 ercent and 90 percent of full scale when using he transmitter RF head PWR OUT PEAK con- ol.

n. If the meter indication in *m* above cannot e obtained, repeat *l* above.

o. Set the AC POWER switch to OFF.

p. Carefully slide the shaft of frequency multiplier assembly 6A2 into the coupling of the flexible drive shaft. Secure 6A2 to the chassis with the four screws provided.

q. Set the AC POWER switch to ON/RESET.

r. Set the XMTR TUNE and XMTR CHANNEL controls to channel 40.

s. Set the transmitter meter switch to MULT position. Check to see that the meter indicates between 25 percent and 90 percent of full scale.

t. Set the meter switch to the DRIVER and PWR OUT positions in turn, and check to see that the meter indicates between 25 percent and 90 percent of full scale when tuning the PWR OUT PEAK control.

u. If the meter indications are below normal in MULT, DRIVER and PWR OUT positions, reset the XMTR TUNE and XMTR CHANNEL controls to channel 340 and repeat steps *l* through *t* above.

v. Repeat steps *s* through *t* above for channels 179, 180, and 400.

w. Set the AC POWER switch to OFF. Disconnect the CMC 456–918 cable from the transmitter case and the transmitter RF head. Disconnect the dummy load, from Cable Assembly, RF CG–3444/U (1 ft 6 in.).

3–54. Replacement of RF Power Level Control 6A5

a. Place the transmitter RF head upright and locate 6A5 (fig. 3–6).

b. Disconnect the RF lead from chassis connector 6W1J1, and the RF lead from connector J6 of electronic switch 6A1.

c. Loosen and remove the two green-circled screws and remove the 6A5 module.

d. Install the new 6A5 module and tighten the two green-circled mounting screws. Connect the P2 (6W1J1) lead to chassis connector 6W1–J1 and the P1 (QA1J6) lead to the connector of electronic switch 6A1.

3–55. Replacement of Power Supply 1RE1PS1, Pulse Form Restorer 1RE1A3, Electrical Frequency Limiter-Discriminator 1RE1A4, Intermediate Frequency Amplifier 1RE1AR2, Amplifier-Frequency Multiplier 1RE1A5, Bandpass Filter 1RE1FL1, and Video Amplifier 1RE1AR1

Replacement of these modules is described in chapter 6 of TM 11–5820–540–12.

3–56. Replacement of Electrical Frequency Synthesizer 1RE1A2

a. Place radio receiver 1RE1 bottom side up and locate 1REA2 (fig. 3–32). Disconnect the leads from connector J2 of bandpass filter 1RE1FL1 and connector J1 of video amplifier 1RE1AR1.

b. Loosen the four green-circled screws and lift 1RE1A2 with the attached modules straight up from chassis to disengage the connectors. If the connectors do not separate easily, pry chassis and module apart with a screwdriver but do not touch the mating connectors.

c. On 1RE1A2, locate pulse form restorer 1RE1A3, electrical frequency limiter-discriminator 1RE1A4, intermediate frequency amplifier 1RE1AR2, amplifier-frequency multiplier 1RE–1A5, and bandpass filter 1RE1FL1. Remove each of these modules as described in chapter 6 of TM 11–5820–540–12.

d. To reinstall the 1RE1A2 replacement module, first attach the modules listed in *c* above to 1RE1A2, as described in chapter 6 of TM 11–5820–540–12. Place 1RE1A2 in position on the chassis and press straight down to engage the connectors. Tighten the four mounting screws.

e. Connect the P1 (1RE1FL1J2) RF lead to connector J2 of 1RE1FL1, and plug P2 from 1RE1A4 to connector J1 of 1RE1AR1.

3–57. Replacement of Buzzer 1RE1A1DS5

a. Place radio receiver 1RE1 upright and locate module 1RE1A1DS5 (fig. 3–29) behind the front panel.

b. Remove power supply 1RE1PS1 as described in Chapter 6 of TM 11–5820–540–12.

c. Unsolder the two leads from the 1RE1A1–DS5 terminals; note the polarity and tag the leads.

d. Loosen the two screws holding the buzzer to the chassis.

e. To install the 1RE1A1DS5 replacement module place buzzer over the two mounting holes and tighten the mounting screws.

f. Resolder the two leads to their proper terminals.

g. Reinstall power supply 1RE1PS1 as described in chapter 6 of TM 11–5820–540–12.

3–58. Replacement of Control Alarm 1RE1A1A2

a. Place radio receiver 1RE1 top side up and locate 1RE1A1A2 (fig. 3–29) behind the front panel.

b. Remove power supply 1RE1PS1 as described in chapter 6 of TM 11–5820–540–12.

c. Remove circuit card assembly 1RE1A1A mounting screws and pull 1RE1A1A3 away fro 1RE1A1A2.

d. Remove the two mounting screws and pu 1RE1A1A2 free of the monitor panel 1RE1A1.

e. Unsolder and tag the leads from 1RE1A1 A2 terminals. Remove 1RE1A1A2.

f. Position the new 1RE1A1A2 above i mounting posts. Reconnect and solder the wir removed in *e* above.

g. Reposition 1RE1A1A2 and secure with t two mounting screws.

h. Reinstall power supply 1RE1PS1 as d scribed in chapter 6 of TM 11–5820–540–12.

3–59. Replacement of Control-Indicator 2A2, Electronic Switch 2A4, Power Supply 2PS1, and Intermediate Frequency Amplifier 2A1A2AR1

Replacement of these modules is described chapter 6 of TM 11–5820–540–12.

3–60. Replacement of the Radio Frequency Amplifier 2A1AR1

a. Place the receiver rf head bottom si up and locate radio frequency amplifier 2A1AR

b. Locate the module extractor tool stored the chassis (fig. 3–16).

c. Disconnect the two RF leads from conn tors J1 and J2 on 2A1AR1.

d. Loosen the four green-circled mounti screws of 2A1AR1 and use the extractor tool remove the module.

e. To install the 2A1AR1 replacement m ule, position the module over the four mounti holes and press down to engage the connect Tighten the mounting screws. Connect the (2A1AR1J2) lead to connector J2 and the (2A1AR1J1) lead to the connector J1 on ra frequency amplifier 2A1AR1.

3–61. Replacement of Power Monitor 2A1A

a. Removal of 2A1A5 is a second-order rem al. Control-indicator 2A2 must be removed fi as described in chapter 6 of TM 11–5820–540–2.

b. Place the receiver RF head bottom side and locate 2A1A5 (fig. 3–16).

c. Disconnect connector J1 (ANT.) from front panel. Disconnect the power monitor rf l from connector J1 of impedance matching work 2A1A1Z1.

d. Loosen the two screws that secure plug P1 (XA1W4J2) to its mating connector and disconect the plug.

e. Loosen the three green-circled mounting crews that secure the power monitor 2A1A5 ounting bracket to the chassis and lift up 2A1A5 ith the bracket attached. Remove the four crews that secure 2A1A5 to the bracket.

f. To install the 2A1A5 replacement module, rst attach the replacement to the mounting acket.

g. Connect plug P1 (XA1W4J2) to chassis nnector 2A1W4J2 and tighten the two plug crews.

h. Slide connector J1 (ANT.) at the end of the F lead through the ANT. opening in the front nel and secure with the hexagonal nut.

i. Connect plug P2 (XA1A1Z1J1) at the d of the RF lead to connector J1 of impedance atching network 2A1A1Z1.

j. Position the replacement module, with the ounting bracket attached, over the three mount- g holes and tighten the mounting screws.

k. Reinstall control-indicator 2A2, as described chapter 6 of TM 11–5820–540–12.

-62. Replacement of Frequency Mixer Stage 2A1A2A2

a. Place the receiver RF head upright and lote 2A1A2A2 (fig. 3–18).

b. Disconnect the RF lead from connector J2 2A1A2A2.

c. Loosen the four green-circled screws and ft up frequency mixer stage 2A1A2A2 from e chassis using the module extractor tool.

d. To install the 2A1A2A2 replacement mode, position the module over the four mount- g holes and press straight down to engage the nnectors. Tighten the mounting screws. Reonnect plug P1 (XA1A2A2J2) at the end of the F lead to connector J2 on 2A1A2A2.

-63. Replacement of Low Pass Filter 2A1A1FL1

a. Place the receiver RF head upright and lote low pass filter 2A1A1FL1 at rear (fig. 3–18). Disconnect the two rf cables connected to connectors J2 and J1 of low pass filter 2A1A1–FL1.

b. Disconnect P3 (2A1A1A1J2) from 2A1A1–1A1J2.

c. Remove the four green-circled mounting screws on power supply 2PS1 and remove 2PS1 by pulling it away from chassis to allow access to one mounting screw of 2A1A1FL1.

d. Remove the two countersunk mounting screws of 2A1A1FL1 and remove 2A1A1FL1 through the access hole located at the bottom of the left side of the chassis.

e. Insert the replacement 2A1A1FL1 through the access hole at the bottom of the left side of the chassis and secure it to the chassis using the two countersunk screws.

f. Replace power supply 2PS1 by plugging P1 of 2PS1 into J5 (XPS1P1) and replace the four green-circled mounting screws removed in *c* above.

g. Connect the P2 (2A1A1FL1J1) cable to connector J1 of low pass filter 2A1A1FL1.

h. Connect the P2 (2A1A1A1J2) cable to the 2A1A1A1J2 bulkhead connector (fig. 3–18).

i. Connect the P1 (2A1A1FL1J2) cable to connector J2 of low pass filter 2A1A1FL1.

3–64. Replacement of Buzzer 9A1DS1

a. Loosen the four green-circled captive screws that secure the rear panel of the order wire unit case.

b. Pull the rear panel away from case (fig. 3–40). Locate buzzer 9A1DS1 on rear panel.

c. Unsolder the two leads connected to 9A1DS1; tag the leads.

d. Loosen the two screws that hold 9A1DS1 to the rear panel.

e. To install the 9A1DS1 replacement module, place the buzzer over the two mounting holes and tighten the mounting screws.

f. Resolder the two leads to 9A1DS1; observe correct polarity of leads.

g. Reinstall the rear panel and tighten the four green-circled mounting screws.

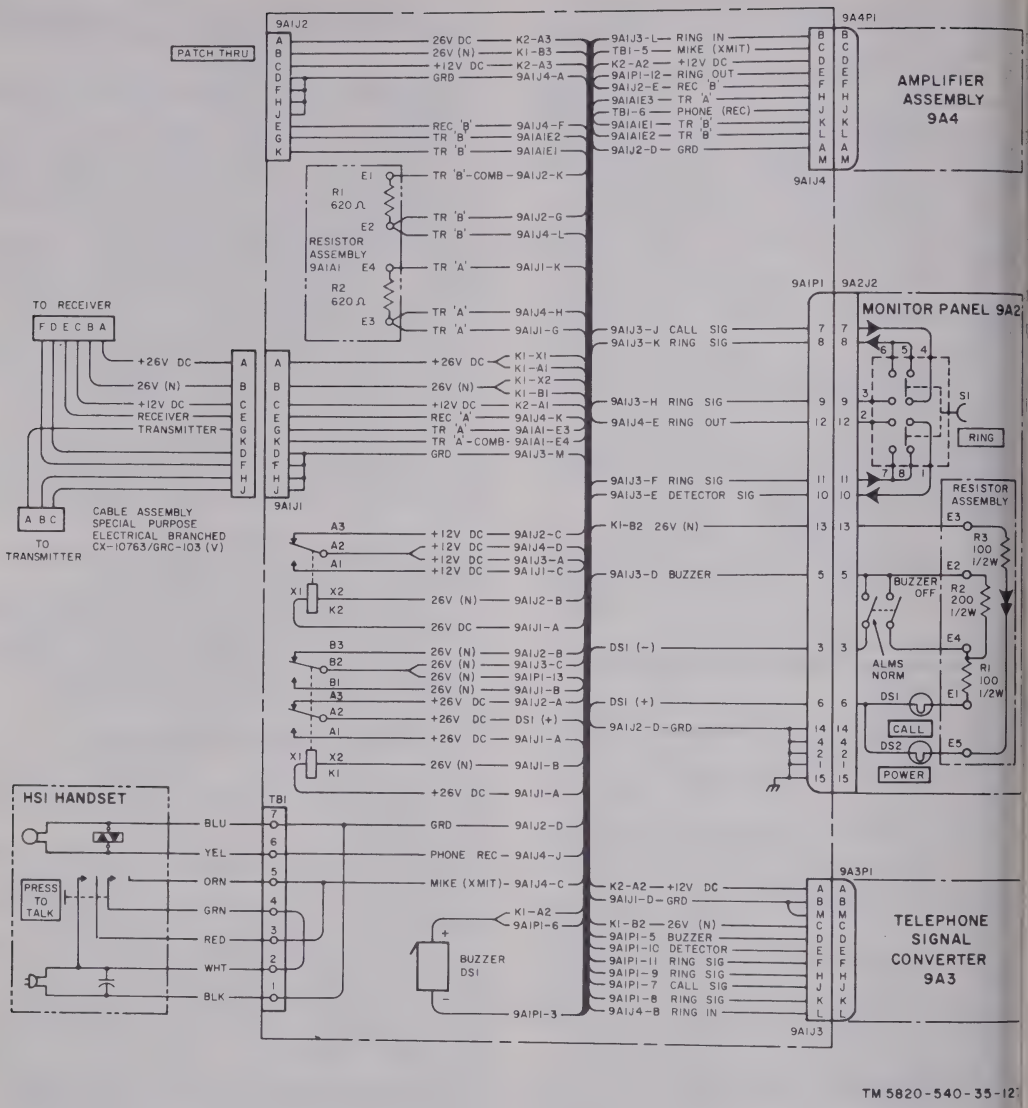


Figure 3-41. Receiver-transmitter order wire RT-773/GRC-103(V), interconnection diagram.

Section IV. TROUBLESHOOTING (BAND II)

3-65. General

This section contains the systematic troubleshooting procedures required to sectionalize a fault in the radio set and to trace the fault to the defective module or part. Meter readings may help in locating faults without the help of test equipment or measuring circuits. Operational tests frequently indicate the general location of trouble and in many instances help in determining the nature of the fault. The operational check, loop testing procedure and the troubleshooting charts contained in TM 11–5820–540–12 are suitable starting points. The modified loop test procedure, troubleshooing charts and signal substitution procedures enable direct support personnel to quickly localize the faulty module. Replacement of one or more suspected defective modules may be a quick and effective method of repairing a radio set in emergency conditions.

3-66. Additional Test Equipment Required

In addition to the test equipment required in paragraph 3–2, the following equipment is required for Band II radio set maintenance.

a. Test Equipment.

Equipment	Common Name	Qty
Generator, Signal SG–340A/G.	Signal generator No. 2	1
Attenuator fixed Empire Devices AT–75–10.	10-db attenuator	1
Attenuator fixed Empire Devices AT–75–20.	20-db attenuator	1

b. Connectors.

Connector	Qty
Adapter-connector Omni Spectra 21010 (type N female to OSM female).	2
Adapter-connector Omni Spectra 21020 (type N male to OSM female).	2
Adapter-connector Omni Spectra 21170 (type BNC female to OSM female).	1
Adapter-connector UG–29B/U (type N female to N female).	2

c. Cable Assembly, Radio Frequency.

Cable No.	Connector type
CG–3444/U (3 ft 6 in.) (2 required).	Type C male to type C male.
CG–409H/U (3 ft)	Type BNC male to BNC male.
CG–3573/U (4.8 in.) (2 required).	Type OSM male to OSM male.

d. Special Tool.

Wrench, torque 9 in.-lb open end 5/16".

3–67. Loop Test Procedure

Refer to paragraph 3–4.

3–68. Transmitter Troubleshooting

CAUTION

The transmitter RF head when extended must be air cooled during tests; a cooling fan must be pointed toward the power amplifier tubes at all times. If a cooling fan is not available the transmitter RF head *must not be operated for longer than 5-minute periods.* Another alternative is to place the transmitter RF head back into the transmitter case while troubleshooting radio transmitter 5TR1.

a. General. The troubleshooting chart contains troubleshooting procedures for radio transmitter 5TR1 and the transmitter RF head. Paragraphs 3–70 through 3–75 contain test procedures for the transmitter RF head only. Refer to paragraphs 3–8 through 3–12 for test procedures for radio transmitter 5TR1. For more effective troubleshooting of the transmitter remove the transmitter RF head and radio transmitter 5TR1 from the transmitter case. Remove the transmitter RF head dust cover. Connect the transmitter RF head to the transmitter case using CMC 456–918 extender cable and connect radio transmitter 5TR1 to the transmitter case using CMC 456–916 and CMC 456–917 extender cables. Connect the transmitter to a 115 volts, 47- to 420-Hz source and proceed to troubleshoot the transmitter.

CAUTION

The transmitter RF head PWR OUT connector must be connected to the dummy load during troubleshooting. Damage to the equipment will result if this is not done.

b. Transmitter Troubleshooting Chart.

Symptom	Probable cause	Checks and corrective measures
1. When AC POWER switch is set to ON/RESET centrifugal fan does not start, AC POWER and LOW POWER lamps do not light, buzzer does not sound.	*a.* Defective power supply 5TR1PS1. (fig. 3-1). *b.* Defective switch 5TR1A1CB1. (fig. 3-3).	*a.* Check for 115v ac at connector J3 (5TR PS1P1) pins 6 and 7 (para 3-8). If volta is present, replace 5TR1PS1 (para 3-47 *b.* If voltage not present in *a* above, check f 115v ac at switch LINE and LOA terminals. If indications are normal mal wiring continuity checks. (fig. 6-14).
2. 28V DC and 12V DC metering reads negative, all other metering zero, LOW POWER and SYNC lamps light.	Short circuit	Check for short on 28v supply line (figs. 6-1 7-2).
3. 12V DC reads negative, 28V DC full scale, 600V DC high, DRIVER normal, all other metering zero. LOW POWER and SYNC lamps light.	Short circuit	Check for short on 12v supply line (figs. 6-1 7-2).
4. All metering reads zero, all lamps are inoperative, centrifugal fan operates.	Short circuit	*a.* Check for short on 26v supply line (fig 6-14, 7-2). *b.* Check for short on 600v supply line (fig 6-14, 7-2).
5. 28V DC normal or zero, 12V DC normal, DOUBLER, MULT, DRIVER and PWR OUT low, OSC high. LOW POWER and SYNC lamps light.	Open circuit	Check for open 28v supply (figs. 6-14, 7-2).
6. When AC POWER switch is set to ON/RESET, centrifugal fan does not start; AC POWER, LOW POWER, and OVERHEAT lamps light; buzzer sounds.	*a.* Defective centrifugal fan 5A2B1 (TM 11-5820-540-12, fig. 6-9). *b.* Defective power supply 5TR1PS1 (fig. 3-1)	*a.* Check for 140v ac at connector J5 (5A2B1P pins 1 and 2 (transmitter case). If volta is present replace 5A2B1 (TM 11-582 540-12, fig. 6-9). *b.* (1) Check for 140v ac at power supp filter terminals FL5 and FL6 5TR1PS1 (figs. 3-1, 3-2). If no vo age is present replace 5TR1P (para 3-47). (2) If voltage is present at FL5 and F of 5TR1PS1 but not at pins 1 and 2 connector J5 (5A2B1P1) in the tra mitter case, remove 115v ac pow source and check for continuity b tween these two points (fig. 6-14).
6.1. When AC POWER switch is set to ON/RESET, centrifugal fan does not start. OVERHEAT lamp is not on. Buzzer may or may not sound. All other indications normal.	a. Defective OVERHEAT lamp 5TR1A2A2DS4. b. Defective pressure differential monitor 5A2A2.	a. Change indicator lamp 5TR1A2A2DS4. b. Higher category maintenance required.

Symptom	Probable cause	Checks and corrective measures
7. Buzzer does not sound when an alarm lamp lights or goes out.	*a.* Defective buzzer 5TR1A1DS5 (fig. 3–3).	*a.* Check for +26v dc at buzzer terminals. If voltage is present replace the buzzer (para 3–49).
	b. Defective switch 5TR1A1S2 (fig. 3–3).	*b.* Higher category of maintenance is required.
	c. Defective alarm control 5TR1-A1A2 (fig. 3–3).	*c.* If continuity is broken because of 5TR1A1A2, replace 5TR1A1A2 (para 3–48).
8. SYNC lamp does not go out within 10 seconds after AC POWER switch is set to ON/RESET.	*a.* Defective synthesizer 5TR1A2 (fig. 3–3).	*a.* Extend the synthesizer (para 3–10) and check for +12v, 26v (N) and +28v at J1 (X5TR1A2P2) (fig. 3–3). If normal indications are obtained, replace synthesizer 5TR1A2 (para 3–45).
	b. Defective power supply 5TR1PS1 (fig. 3–1).	*b.* If indications in *a* above are abnormal, check 5TR1PS1 (para 3–8). If abnormal indications are obtained replace 5TR1PS1 (para 3–47).
81. OVERHEAT lamp does not go off within 10 seconds after AC POWER switch is set to ON/RESET.	**Defective pressure differential monitor 5A2A2.**	**Higher category maintenance required.**

Symptom	Probable cause	Checks and corrective measures
. DRIVER metering greater than 100%.	Short circuit in voltage regulator assembly 37AR1A1A1 or RF amplifier 37AR1AR1 (fig. 3-44).	Replace voltage regulator assembly and two electron tubes. If indication becomes normal, replace one original tube. If the indication still remains normal, replace the other original tube. If indications still remain normal, then only the voltage regulator assembly 37AR1A1 was shorted. If the indication after replacement of the tubes and voltage regulator assembly does not become normal, higher category of maintenance is required.
). LOW POWER lamp does not go out within 60 seconds after AC POWER switch is set to ON/RESET. PWR OUT position reads low.	*a.* Defective RF power monitor 37AR1A2 (fig. 3-44).	*a.* Measure power (25 watts) at P2 (37AR1-A2J1) (fig. 3-44). If normal, check 37-AR1A2 (para 3-75).
	b. Defective low pass filter 37AR1A1FL1 (fig. 3-44).	*b.* If power indication at 37AR1A1FL1J2 is abnormal, measure the power at P2 (37-AR1A1FL1J1) (para 3-72). If normal, check 37AR1A1FL1 (para 3-74).
	c. Defective radio frequency amplifier 37AR1AR1 (fig. 3-44).	*c.* If abnormal indication is obtained in *b* above, measure the power at 37A1J2 (para 3-71). If normal, higher category maintenance is required.
. LOW POWER lamp does not go out within 60 seconds after AC POWER switch is set to ON/RESET. PWR OUT position reads low, DRIVER position reads high.	No output cathode regulation	Remove transmitter 5TR1 and measure the resistance from pin 30 of connector J8 (X5TR1A1A1P3) (transmitter case) (fig. 6-9) to ground (approximately 12 ohms). If normal, replace 5TR1PS1 (para 3-47). If abnormal, check voltage regulator assembly 37AR1A1A1 (para 3-73).
2. LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. PWR OUT position reads low, DRIVER position reads low.	*a.* Defective voltage regulator 37AR1A1A1 (fig. 3-44).	*a.* (1) Measure the power (3.5 watts minimum) at 37AR1AR1J3 (fig. 3-44). If normal, check the voltage at TP2 and TP4 of 37AR1A1A1 (para 3-73). If normal, disconnect the transmitter RF head and measure the resistance between TP2 and TP4 of voltage regulator assembly 37AR1A1A1 (fig. 3-44) (should be 1.5 ohms approximately). (2) If voltage at TP2 and TP4 is abnormal check the output heater/output cathode circuit of 5TR1PS1 (para 3-8). (3) If 5TR1PS1 check is normal, check continuity of output heater/output cathode wiring between 5TR1PS1 and transmitter RF head (figs. 6-14 and 7-2).
	b. Defective amplifier subassembly 37AR1AR1 (fig. 3-44).	*b.* If the power at 37AR1AR1J3 (para 3-72) is abnormal, higher category maintenance is required.
	c. No driver cathode voltage	*c.* Remove the radio transmitter 5TR1 from the case and measure the resistance from pin 29 of connector J8 (X5TR1A1A1P3) (fig. 6-9) to ground (34 ohms approximately). If normal, replace 5TR1PS1 (para 3-47). If abnormal, check voltage regulator assembly 37AR1A1A1 (para 3-73).
	d. Defective driver cathode/driver heater.	*d.* Measure the power at 37A1J2 (fig. 3-42) (para 3-71). If normal, check the voltage across TP1 and TP3 of voltage regulator assembly 37AR1A1A1 (para 3-73). If

Symptom	Probable cause	Checks and corrective measures
		normal, disconnect the transmitter h head and measure resistance betwe TP1 and TP3 of voltage regulator assem 37AR1A1A1 (fig. 3-44) (should be ohm approximately). If voltage at T and TP3 is abnormal, check the dri heater/driver cathode circuit of 5TR1F (para 3-8). If 5TR1PS1 check is norm check the continuity of the driver heat driver cathode wiring between 5TR1F and transmitter RF head (figs. 6-14, 7-
	e. Defective RF amplifier 37AR1AR1 (fig. 3-44).	*e.* If driver cathode/driver heater circuit normal, higher category maintenance required.
13. At channel 760 and above or channel 759 and below, LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. PWR OUT position reads low, DRIVER position reads low and MULT position reads low.	Defective frequency multiplier 37A1 (fig. 3-44).	*a.* Check the output of 37A1 (para 3-7 Check the continuity of 26V UNR and 28V REG wiring between 5TR1F and transmitter RF head (figs. 6-14, 7-
14. Same as 13 above but at all channels.	*a.* Defective wiring	*a.* Measure power into frequency multip at 37A1J1 (2.5 watts minimum) (p 3-11). If abnormal, check for continu from 37A1J1 to pin A2 of J11 (X5T A4P1) (figs. 6-14, 7-2).
	b. Defective amplifier-frequency multiplier 5TR1A4 (fig. 3-3).	*b.* If the wiring continuity check in *a* abov normal, replace 5TR1A4 (para 3-46)
15. LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. DRIVER position reads low, MULT position reads low, DOUBLER position reads low.	*a.* Defective amplifier-frequency multiplier 5TR1A4 (fig. 3-3).	*a.* Measure the power at pin A1 of J11 (X5T A4P1) (para 3-10). If it is normal, ch 5TR1A4 (para 3-11).
	b. Defective wiring	*b.* Check for +28v at pin 1 and check ground at pin 17 of J11 (X5TR1A4 (para 3-11) with the transmitter RF h connected.
16. LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. DRIVER position reads low, MULT position reads low, DOUBLER position reads low, OSC position reads low.	*a.* Defective electrical-frequency synthesizer 5TR1A2 (fig. 3-3).	*a.* Check synthesizer 5TR1A2 (para 3-10).
	b. Defective wiring	*b.* Check inputs to 5TR1A2 at J1 (X5T A2P1) (fig. 6-14): pin 1 +28v dc pin 3 0v pin 2 +12v dc pin 37 +28v dc.
17. SYNC alarm does not go out within 10 seconds after AC POWER switch is set to ON/RESET.	*a.* Defective synthesizer 5TR1A2 (fig. 3-3). *b.* Defective power supply 5TR1PS1 (fig. 3-1).	*a.* Check synthesizer 5TR1A2 (para 3-10). *b.* Check power supply 5TR1PS1 (para 3-8)
18. When AC POWER switch is set to ON/RESET, buzzer and centrifugal fan operate, LOW POWER and SYNC alarm lights come on, DRIVER metering is low, all other metering reads zero.	Defective power supply 5TR1PS1 (fig. 3-1).	Check voltage regulator amplifier 5TR1PS1A1 of power supply 5TR1PS1 (para 3-8).
19. No communication. Metering and LOW POWER and SYNC alarms may or may not indicate normal.	Synthesizer off frequency due to— *a.* Defective synthesizer 5TR1A2 (fig. 3-3). *b.* Defective wiring	*a.* Check synthesizer (para 3-10). *b.* Check wiring from control-indicator 3A2 to the synthesizer (figs. 6-14, 7-2).

-69. Receiver (Band II) Troubleshooting

a. General. The troubleshooting chart contains oubleshooting procedures for radio receiver RE1 and the receiver RF head. Paragraphs 3-76 rough 3-86 contain test procedures for the ceiver RF head only. Refer to paragraphs 3-32 rough 3-39 for test procedures for radio ceiver 1RE1. For more effective troubleshooting of the receiver, remove the receiver RF head and radio receiver 1RE1 from the receiver case. Remove the receiver RF head dust cover. Connect the receiver RF head to the receiver case using CMC 456-921 extender cable. Connect the radio receiver 1RE1 to the receiver case using CMC 456-919 and CMC 456-920 extender cables. Connect the receiver to a 115 volt, 47- to 420-Hz source and proceed to troubleshoot the receiver.

b. Receiver Troubleshooting Chart.

Symptom	Probable cause	Checks and corrective measures
1. With AC POWER switch set to ON, there are no meter indications and no alarms.	Defective switch 1RE1A1CB1 (fig. 3-32).	Check for 115v ac at switch LINE and LOAD terminals (fig. 3-32). If switch is normal, make wiring continuity checks (fig. 6-29).
2. Buzzer does not sound when any alarm lamp lights or goes out.	Defective buzzer 1RE1A1DS5 (fig. 3-29).	Check for 26v dc at buzzer terminals (fig. 3-29). If voltage is present, replace buzzer (para 3-57). If voltage is not present, make wiring continuity checks (fig. 6-29).
3. LOW SIGNAL alarm is on; RCVR SIG metering reads low.	*a.* Defective vf power monitor 33A3 or duplexer subassembly 33A1A1 (figs. 4-226, 3-56).	*a.* Inject a signal at −65 dbm at receive frequency into P1 (33A1A1J2) (fig. 3-49). If the alarm clears, higher category of maintenance is required.
	b. Defective signal level control-monitor 33A5 (fig. 3-49).	*b.* If the alarm condition remains, inject signal into P1 (33A5J2) (fig. 3-53). If the alarm clears, replace signal level control-monitor 33A5 (para 3-95).
	c. Defective low-pass filter 33FL1 (fig. 3-49).	*c.* If the alarm condition remains, inject the signal into P1 (33FL1J2) (fig. 3-49). If the alarm clears, replace low pass filter 33FL1 (para 3-99).
	d. Defective frequency mixer stage 33A7, **(fig. 3-49).**	*d.* If the alarm condition remains, remove frequency mixer stage 33A7 (para 3-97) and feed a signal of 30 MHz at −35 dbm into pin A1 of 33A1W1J8 (fig. 3-56). **If alarm clears, frequency mixer stage 33A7 is defective. Check frequency mixer stage 33A7 (para 3-83).**
	e. Defective intermediate frequency amplifier 33AR1 (fig. 3-56).	*e.* If alarm remains inject a 30 MHz signal at a level of —35 dbm into 33A1W1-A1P2 (fig. 3-56). If alarm clears, replace intermediate frequency amplifier 33AR1 (para 3-96).
	f. Local oscillator off frequency due to—	
	(1) Defective synthesizer 1RE1A2 (fig. 3-32).	*f.* (1) Check synthesizer (para 3-33).
	(2) Defective wiring	(2) Check wiring from control indicator 33A4 to J3 (X1RE1A2P2) (figs. 6-29, 7-7).
4. LOW SIGNAL alarm, RCVR SIG reading low; MULT reading low.	*a.* Defective frequency multiplier 33A2A1 or 33A2A2 (fig. 3-49).	*a.* Check the output power level at P1 (33A-7J2), (para 3-81). If abnormal, replace receiver RF head.
5. SYNC alarm and/or LOW SIGNAL alarm, RCVR SIG reading low, MULT reading low, OSC reading low.	*a.* Defective synthesizer 1RE1A2 (fig. 3-32).	*a.* Check supply voltages at J3 (X1RE1A2P2). If normal, change synthesizer IRE1A2 (para 3-56). If abnormal, check wiring (fig. 6-29).

3-70. Control-Indicator 37A2

a. Test Equipment Required.

Equipment	Common name
Multimeter TS-352B/U	Multimeter
Cable Assembly, Special Purpose, Electrical CMC 456-922.	
Cable Assembly, Special Purpose, Electrical CMC 456-918.	

b. Operational Checks.

(1) Loosen the two screws securing plug P1 (37AR1A1W1J3) to chassis connect 37AR1A1W1J3 (fig. 3-42). Disconnect P1 fro 37AR1A1W1J3.

(2) Set the XMTR CHANNEL control t channel 624.

(3) Using the multimeter, check for corre

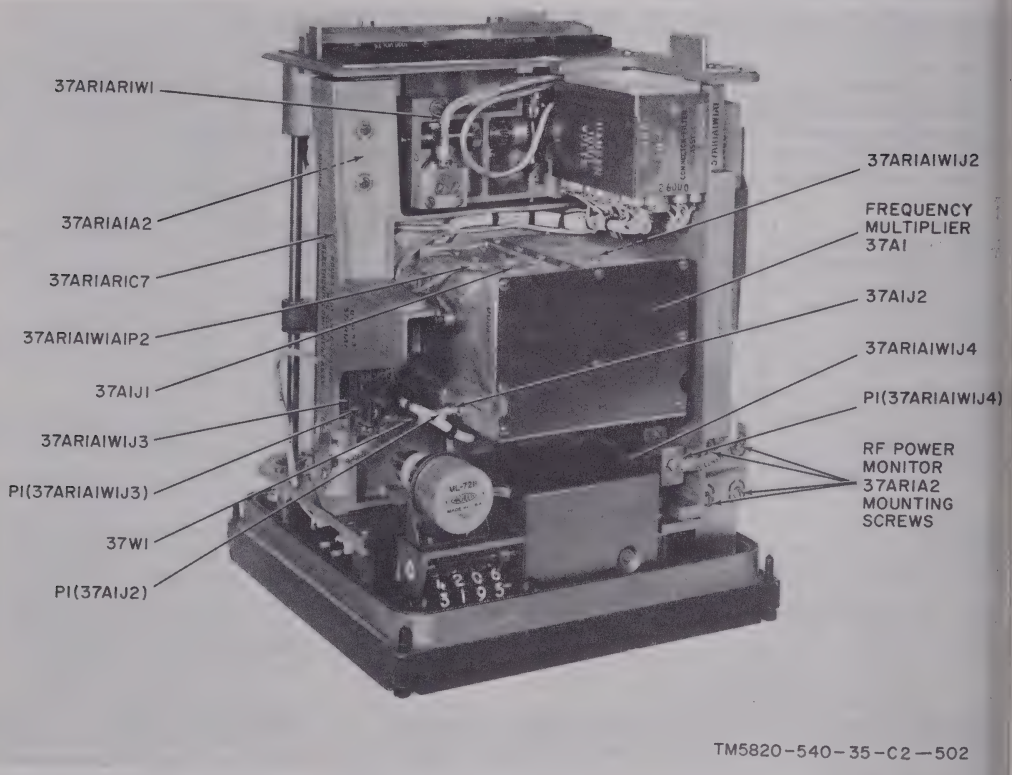


Figure 3-42. Band II transmitter RF head, top view.

sistance between the following pins of P1 7AR1A1W1J3) as shown in the chart below.

Pins	Resistance
and 14	Infinity
and 14	Infinity
and 14	Infinity
and 14	Infinity
and 14	infinity
and 14	Infinity
and 14	Infinity
and 14	Infinity
and 14	Infinity
and 14	Infinity
and 14	Zero

(4) Set the XMTR CHANNEL control to hannel 623.

(5) Using the multimeter, check for correct esistance between the following pins of P1 37AR1A1W1J3) as shown in the chart below.

Pins	Resistance
1 and 14	Infinity
2 and 14	Zero
3 and 14	Zero
4 and 14	Zero
5 and 14	Zero
6 and 14	Zero
7 and 14	Zero
8 and 14	Zero
9 and 14	Zero
0 and 14	Zero
1 and 14	Zero
2 and 14	Infinity

(6) Remove control-indicator 37A2 from the ransmitter RF head as described in chapter 6, TM 11–5820–540–12.

(7) Connect plug P1 (37AR1A1W1J3) to hassis connector 37AR1A1W1J3 using cable CMC 456–922.

(8) Remove the four screws securing the control-indicator cover and remove the cover.

(9) Connect the transmitter RF head to the ransmitter case using cable CMC 456–918 and set he AC POWER switch to ON/RESET.

(10) Set the control-indicator to channel 759.

(11) Using the multimeter check the voltage at terminal 24 (pin 13 of P1). The multimeter should indicate zero volt.

(12) Set the control-indicator to channel 760.

(13) Using the multimeter, check the voltage at terminal 24. The indication should be +26 volts dc.

(14) Set the AC POWER switch to OFF. Reinstall the control-indicator cover. If abnormal indications are obtained in either (3), (5), (11), or (13) above, replace control-indicator 37A2. Refer to chapter 6, TM 11–5820–540–12 for replacement procedures.

3–71. Frequency Multiplier 37A1

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM–98	Power meter
Attenuator, Fixed 20-db Empire Devices AT–75–20.	20-db attenuator
Cable Assembly, Special Purpose, Electrical CMC 456–918.	
Cable Assembly, Radio Frequency CG–3573/U (4.8 in.).	
Adapter-Connector Omni Spectra 21010.	Adapter-connector OS21010

b. Operational Check.

(1) Disconnect plug P1 (37A1J2) from connector J2 on frequency multiplier 37A1 (fig. 3–42).

(2) Connect test equipment as shown in figure 3–43.

(3) Set the XMTR CHANNEL and XMTR TUNE control to channel 759.

(4) Set the transmitter AC POWER switch to ON/RESET. The level at 37A1J2 should be +22 dbm minimum.

(5) Set the XMTR CHANNEL and XMTR TUNE control to channel 760. The level at 37A1J2 should be +22 dbm minimum.

(6) Set the AC POWER switch to OFF. If abnormal indications are obtained in either (4) or (5) above, replace the transmitter RF head.

3–72. Radio Frequency Amplifier 37AR1AR1

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM–120	Wattmeter
Cable Assembly, Special Purpose, Electrical CMC 456–918.	
Cable Assembly, Radio Frequency (2 required) CMC 456–931.	
Cable Assembly, Radio Frequency CG–3573/U (4.8 in.) (2 required).	
Adapter-Connector, Omni Spectra 21010 (2 required).	Adapter-connector OS21010
Adapter-Connector UG–29B/U.	

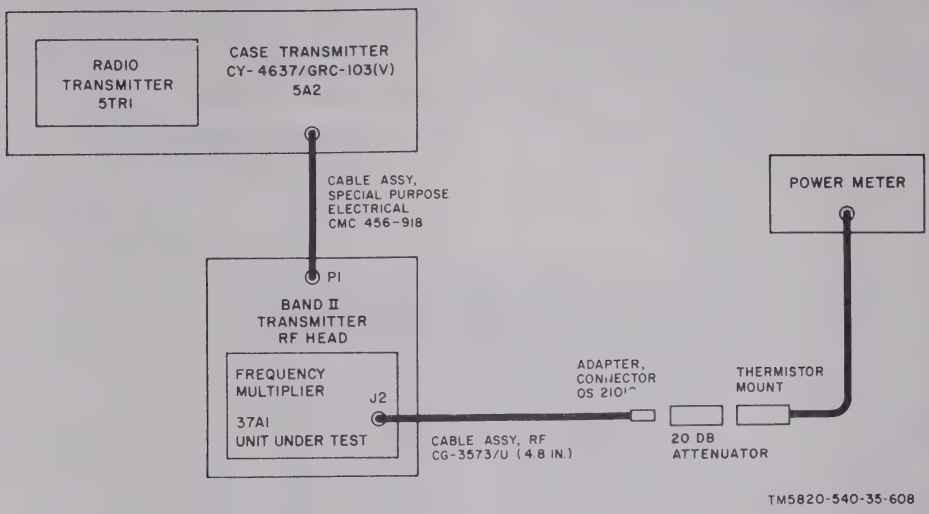


Figure 3-43. Frequency multiplier 37A1 operational check, test setup.

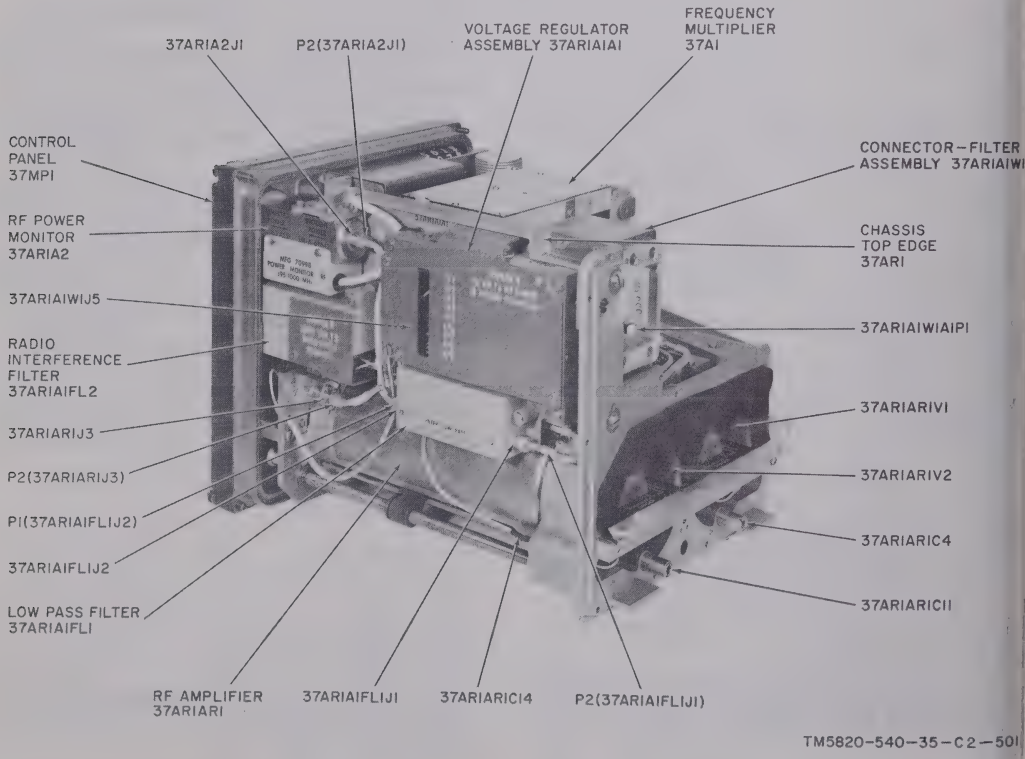


Figure 3-44. Band II transmitter RF head, side view.

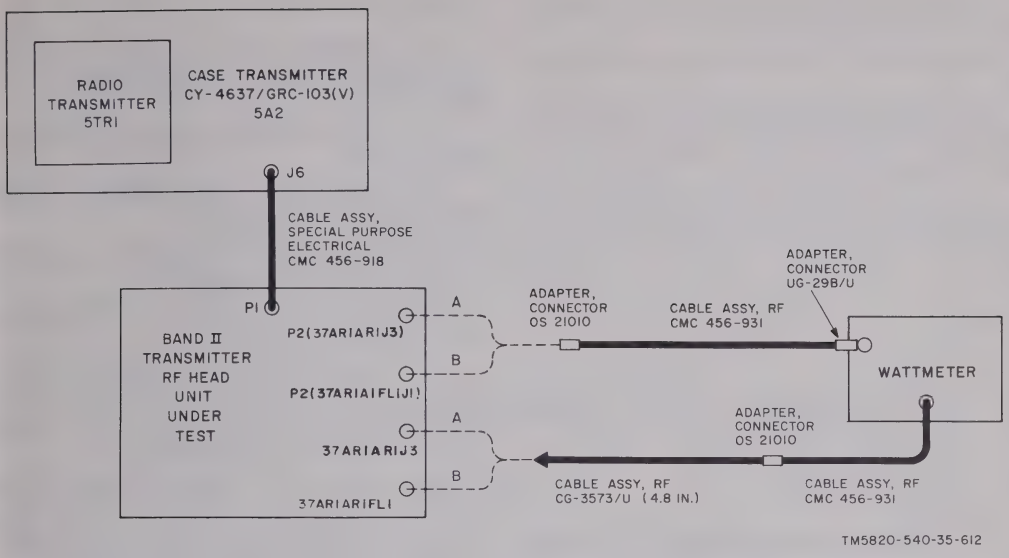


Figure 3–45. Radio frequency amplifier 37AR1AR1 operational check, test setup.

b. Operational Check.

(1) Disconnect P2 (37AR1AR1J3) from connector 37AR1AR1J3 (fig. 3–44).

(2) Connect the test equipment as shown in A, figure 3–45.

(3) Insert the coupler-detector CU–755/URM–120 into the wattmeter.

(4) Set the XMTR CHANNEL and XMTR TUNE control to channel 760.

(5) Set the transmitter AC POWER switch to ON/RESET. The wattmeter should indicate no less than 3.5 watts.

(6) Set the AC POWER switch to OFF.

(7) Reconnect plug P2 (37AR1AR1J3) to connector J3 on 37AR1AR1J3.

(8) Disconnect plug P2 (37AR1A1FL1J1) from connector 37AR1A1FL1J1 (fig. 3–44).

(9) Connect the test equipment as shown in B, figure 3–45.

(10) Set the AC POWER switch to ON/RESET.

(11) Set the meter switch to PWR OUT and adjust the PWR OUT PEAK control for maximum indication on the meter. The wattmeter should indicate 25 watts minimum.

(12) Set the AC POWER switch to OFF.

(13) Reconnect plug P2 (37AR1A1FL1J1) to connector 37AR1A1FL1J1.

(14) Replace the transmitter RF head if abnormal indications are obtained in (5) and (11) above.

3–73. Voltage Regulator Assembly 37AR1A1A1

a. Test Equipment Required.

Equipment	Common name
Multimeter TS–352B/U	Multimeter
Cable Assembly, Special Purpose, Electrical CMC 456–918.	

b. Operational Check.

(1) Remove the transmitter RF head from the case. Remove the dust cover from the RF head and locate voltage regulator assembly 37AR1A1A1 (fig. 3–44).

(2) Connect J6 on the transmitter case to 37AR1A1W1A1P1 (fig. 3–44) on the transmitter RF head using cable CMC 456–918.

(3) Set the XMTR CHANNEL and XMTR TUNE controls to channel 760.

(4) Set the AC POWER switch to ON/RESET.

(5) Set the meter switch to PWR OUT and adjust the PWR OUT PEAK control for maximum indication on the meter.

(6) Using multimeter, check for correct voltage between the following test points on the voltage regulator assembly as shown in the chart below.

Multimeter		Voltage
(+)	(−)	
TP4	TP2	6.3v dc±0.13v
TP3	TP1	6.3v dc±0.13v
TP4	TP5	13.8v dc±0.7v
TP4	TP11	3.2v dc±1.5v
TP3	TP10	3.2v dc±1.5v

(7) Remove voltage regulator assembly 37AR1A1A1 (chapter 6, TM 11-5820-540-12) and check the resistance between the following pins of P1.

Pins	Resistance (ohms ±10%)
14 and 5	12
8 and 5	34
7 and 5	10M
2 and 6	270K

(8) Set the AC POWER switch to OFF. If abnormal indication is obtained in (6) or (7) above, replace voltage regulator assembly 37AR1A1A1. Refer to paragraph 3-92 for replacement procedures.

3-74. Low-Pass Filter 37AR1A1FL1

a. Test Equipment Required.

Equipment	Common name
Wattmeter, AN/URM-120	Wattmeter
Cable Assembly, Special Purpose, Electrical CMC 456-918.	
Cable Assembly, Radio Frequency CG-3573/U (4.8 in.).	
Cable Assembly, Radio Frequency CMC 456-931 (2 required).	
Adapter-Connector, Omni Spectra 21020 (2 required).	Adapter-connector OS21020
Adapter-Connector UG-29B/U (3 required).	

b. Operational Check.

(1) Disconnect plug P1 (37AR1A1FL1J2) from connector J2 on low pass filter 37AR1A1FL1 (fig. 3-44).

(2) Connect the test equipment as shown in figure 3-46.

(3) Insert the coupler-detector CU-755/URM-120 into the wattmeter.

(4) Set the XMTR CHANNEL and XMTR TUNE controls to channel 760.

(5) Set the transmitter AC POWER switch to ON/RESET.

(6) Set the meter switch to PWR OUT and adjust the PWR OUT PEAK control for maximum indication on the meter. The wattmeter should indicate 22 watts minimum.

(7) Set the AC POWER switch to OFF. Replace low pass filter 37AR1A1FL1 if an abnormal indication is obtained in (6) above. Refer to paragraph 3-90 for replacement procedures.

3-75. RF Power Monitor 37AR1A2

a. Test Equipment Required.

Equipment	Common name
Wattmeter, AN/URM-120	Wattmeter
Cable Assembly, Radio Frequency CMC 456-931.	
Adapter-Connector UG-565A/U.	
Cable Assembly, Radio Frequency CG-3444/U (3 ft 6 in.).	
Adapter-Connector UG-29B/U.	
Adapter-Connector UG-564A/U.	
Dummy Load, Electrical DA-437/GRC-103(V).	

b. Operational Check.

(1) Connect the test equipment as shown in figure 3-47.

(2) Insert the coupler-detector CU-755/URM-120 into the wattmeter.

(3) Set the XMTR CHANNEL and XMTR TUNE controls to channel 760.

(4) Set the transmitter AC POWER switch to ON/RESET.

(5) Set the transmitter meter switch to PWR OUT and adjust the PWR OUT PEAK control for maximum indication on the meter. The wattmeter should indicate 21 watts minimum.

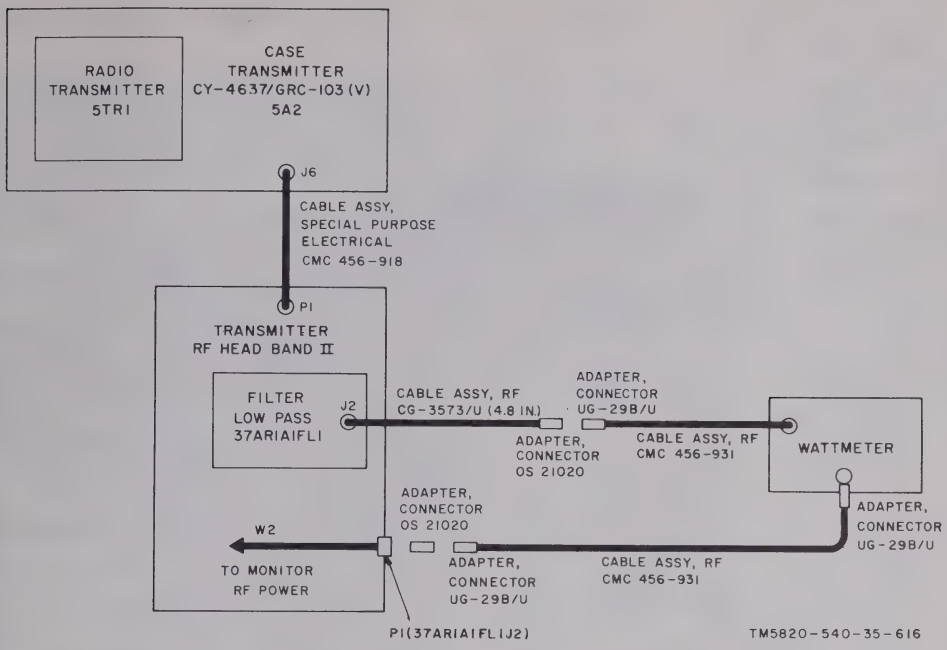


Figure 3-46. Low-pass filter 37AR1A1FL1 operational check, test setup.

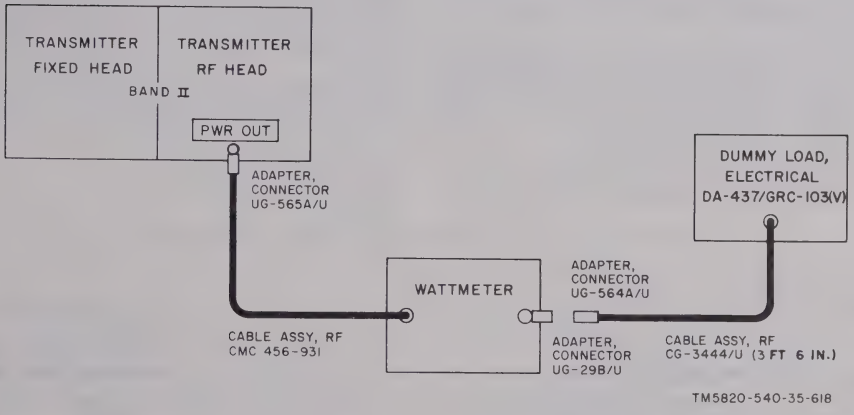


Figure 3-47. RF power monitor 37AR1A2 operational check, test setup.

(6) Set the AC POWER switch to OFF. If bnormal indcation is obtained, replace power ıonitor 37AR1A2 as described in paragraph -91.

-76. Duplexer Subassembly 33A1A1 and Monitor RF Power 33A3

a. Test Equipment Required.

Equipment	Common name
Wattmeter, AN/URM-120	Wattmeter
Generator, Signal SG-340A/G	Signal generator No. 2
Voltmeter, Electronic ME-30A/U.	VTVM
Load, 51 ohms CMC 335-053	Load, 51 ohms
Dummy Load, Electrical DA-437/GRC-103(V).	

Equipment	Common name
Adapter-Connector UG–565A/U. Adapter-Connector UG–29B/U. Adapter-Connector UG–564A/U. Adapter-Connector UG–274/U. Cable Assembly, RF CG–3444/U (1 ft 6 in.). Cable Assembly, RF CG–3444/U (3 ft 6 in.). Adapter-Connector, Omni Spectra 21010. Cable Assembly, Radio Frequency CMC 456–931. Cable Assembly, Radio Frequency CMC 456–930. Cable Assembly, Special Purpose, Electrical CMC 456–921.	Adapter-connector OS21010

b. Operational Check—Transmitter Path.

(1) Connect the test equipment as shown in figure 3–48.

(2) Insert the coupler-detector CU–755/URM–120 into the wattmeter.

(3) Set the XMTR CHANNEL and XMTR TUNE controls to channel 760.

(4) Set the transmitter AC POWER switch to ON/RESET. The wattmeter should indicate 15 watts minimum.

(5) Set the AC POWER switch to OFF. If an abnormal reading is obtained in (4) above, replace the receiver RF head.

c. Operational Check—Receiver Path.

(1) Disconnect plug P1 (33A1A1J2) from connector 33A1A1J2 on duplexer 33A1A1 (fig. 3–49).

(2) Connect the test equipment as shown in A, figure 3–50.

(3) Tune the receiver to channel 640.

(4) Set the frequency of signal generator No. 2 to 520 MHz and adjust the output level until a reading of —50 dbm is obtained on the VTVM. Note the attenuator setting on signal generator No. 2.

(5) Reconnect plug P1 (33A1A1J2) to 33A1A1J2.

(6) Connect the test equipment as shown in B, figure 3–50.

(7) Increase the output of signal generator No. 2 until a reading of —50 dbm is obtained on the VTVM. The output attenuator setting on signal generator No. 2 should not be more than 2.5 db lower than the setting noted in (4) above.

(8) If the indication in (7) above is not obtained, replace the receiver RF head.

3–77. Signal Level Control-Monitor 33A5

a. Test Equipment Required.

Equipment	Common name
Voltmeter, Electronic ME–30A/U.	VTVM
Generator, Signal SG–340A/G.	Signal generator No. 2
Load, 51 ohms CMC 335–053.	Load, 51 ohms
Adapter-Connector, Omni Spectra 21010.	Adapter-connector OS21010
Adapter-Connector UG–274/U.	
Cable Assembly, Radio Frequency CMC 456–930.	
Cable Assembly, Radio Frequency CMC 456–931.	
Cable Assembly, Special Purpose, Electrical CMC 456–921.	

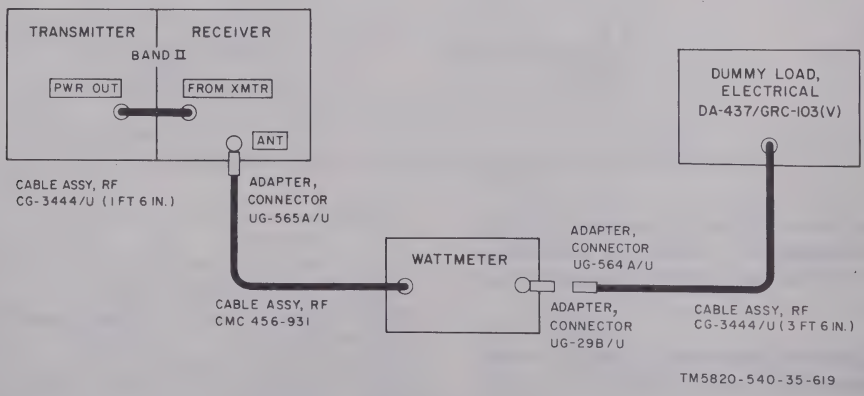


Figure 3–48. Duplexer subassembly 33A1A1 (transmit) operational check, test setup.

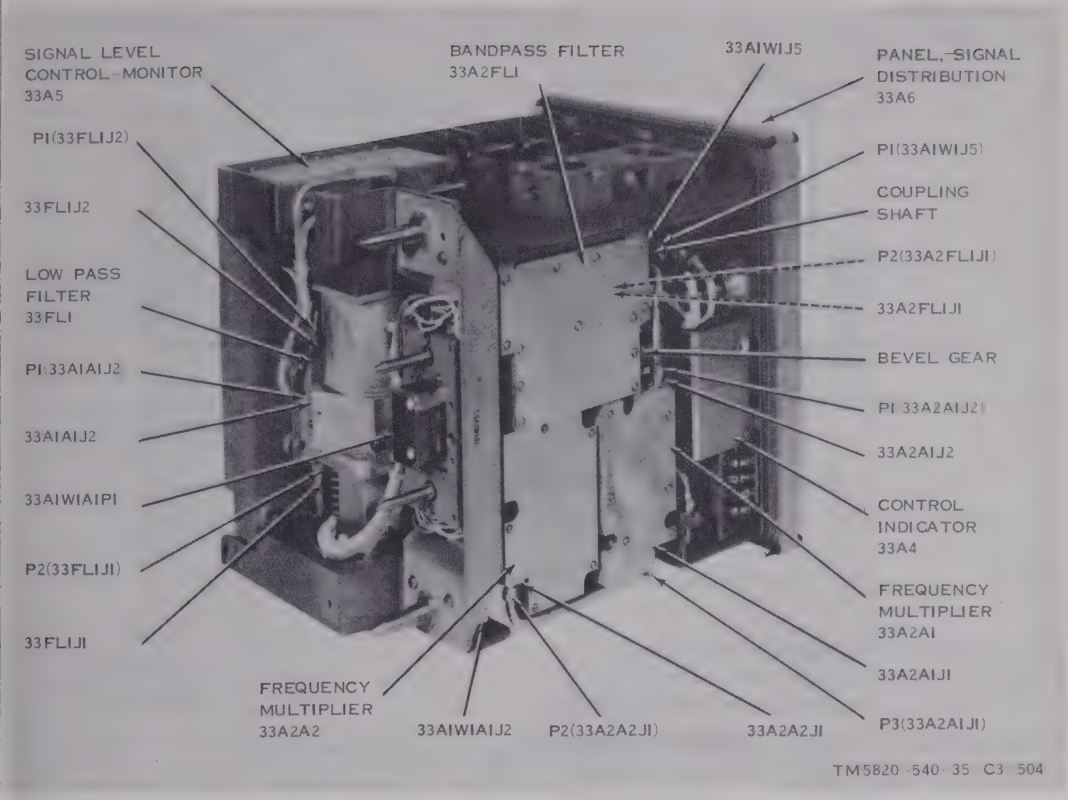


Figure 3–49. Band II receiver RF head, top and rear view.

b. Operational Check.

(1) Disconnect plug P1 (33A1A1J2) (fig. 3–49) from 33A1A1J2 on duplexer 33A1A1.

(2) Connect the test equipment as shown in A, figure 3–51.

(3) Tune the receiver to channel 640 and signal generator No. 2 to 520 MHz.

(4) Set the AC POWER switch to ON.

(5) Increase the output level of signal generator No. 2 until the high signal alarm operates (buzzer may sound if not muted). The signal generator No. 2 level will be 0 dbm ±10 dbm.

(6) Decrease the level of signal generator No. 2 until the VTVM indicates —50 dbm.

(7) Connect the test equipment as shown in B, figure 3–51.

(8) The indication on VTVM should not be higher than —49.25 dbm.

(9) Set the AC POWER switch to OFF.

(10) If the high signal alarm does not come on in (5) above, and/or the indication obtained in (8) above is beyond the specified limit, the unit under test should be replaced. Refer to paragraph 3–95 for replacement procedures.

3–78. Low-Pass Filter 33FL1

a. Test Equipment Required.

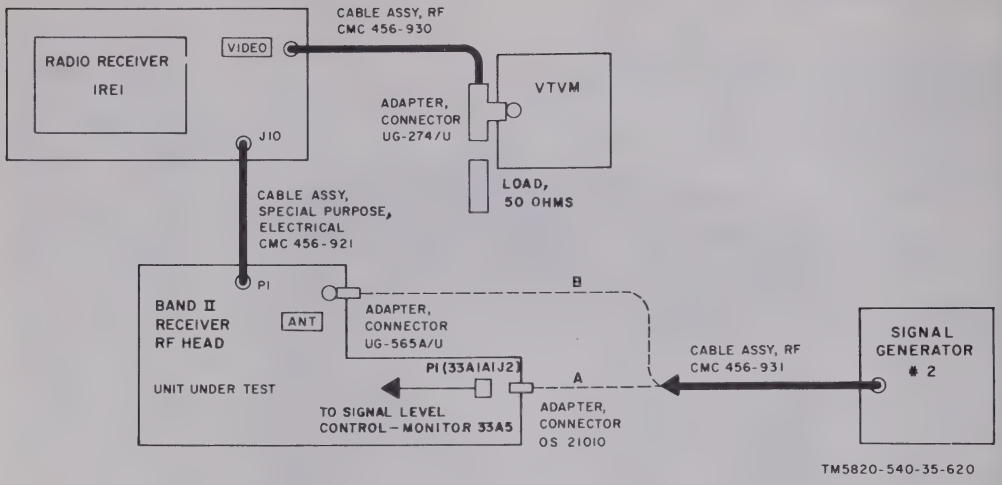


Figure 3–50. Duplexer subassembly 33A1A1 (receive) operational check, test setup.

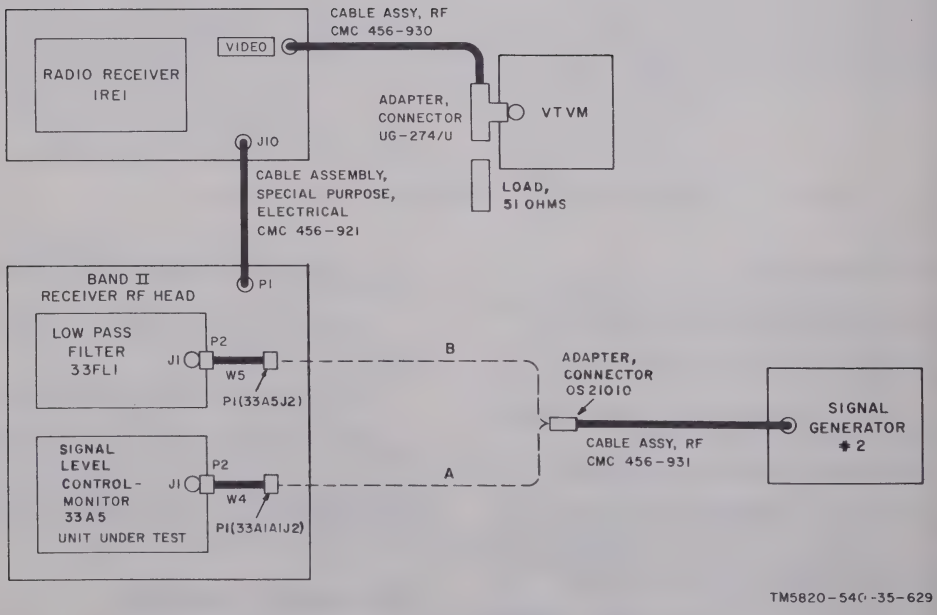


Figure 3–51. Signal level control-monitor 33A5 operational check, test setup.

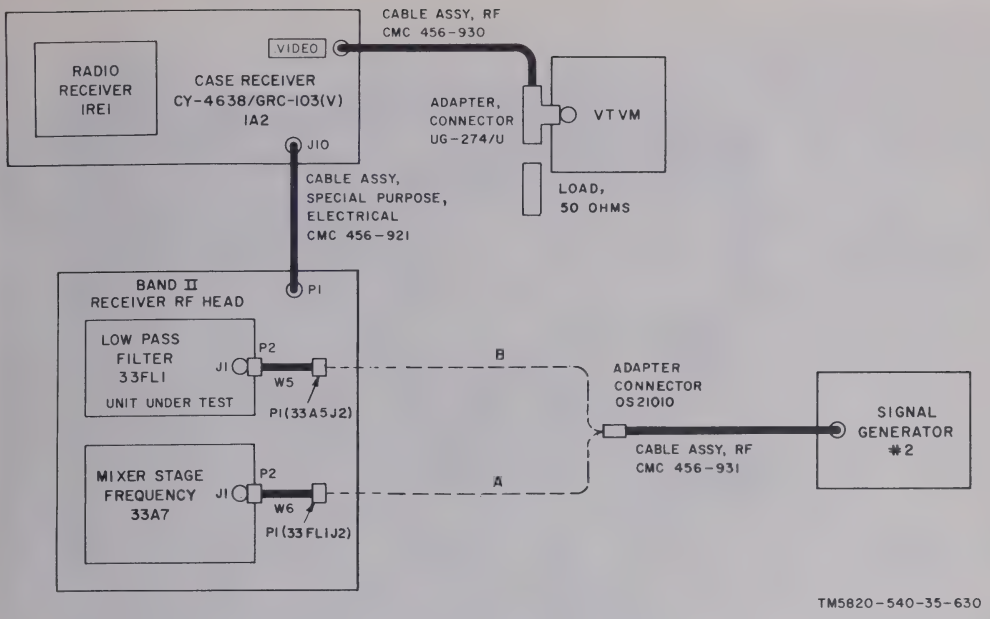


Figure 3–52. Low pass filter 33FL1 operational check, test setup.

Equipment	Common name
Voltmeter, Electronic ME–30A/U.	VTVM
Generator, Signal SG–340A/G.	Signal generator No. 2
Load, 51 ohms CMC 335–053.	Load, 51 ohms
Adapter-Connector, Omni Spectra 21010.	Adapter-connector OS21010
Adapter-Connector UG–274/U.	
Cable Assembly, Radio Frequency CMC 456–930.	
Cable Assembly, Radio Frequency CMC 456–931.	
Cable Assembly, Special Purpose, Electrical CMC 456–921.	

b. Operational Check.

(1) Disconnect plug P1 (33FL1J2) from 33FL1J2 on filter low-pass 33FL1 (fig. 3–49).

(2) Connect the test equipment as shown in A, figure 3–52.

(3) Tune the receiver to channel 640 and signal generator No. 2 to 520 MHz.

(4) Set the AC POWER switch to ON.

(5) Adjust the output level of signal generator No. 2 until a reading of —50 dbm is obtained on the VTVM.

(6) Reconnect plug P1 (33FL1J2) to 33FL1J2.

(7) Disconnect plug P1 (33A5J2) (fig. 3–53) from 33A5J2 on signal level control monitor 33A5.

(8) Connect the test equipment as shown in B, figure 3–52.

(9) The indication on the VTVM should not be lower than —50.5 dbm.

(10) If an abnormal indication is obtained in (9) above, replace 33FL1. Refer to paragraph 3–99 for replacement procedures.

3–79. Frequency Multiplier 33A2A2

a. Test Equipment Required.

Equipment	Common name
Wattmeter, AN/URM–98	Power meter
Attenuator Fixed Empire Devices AT–75–10.	10-db attenuator
Adapter-Connector, Omni Spectra 21010.	Adapter-connector OS21010

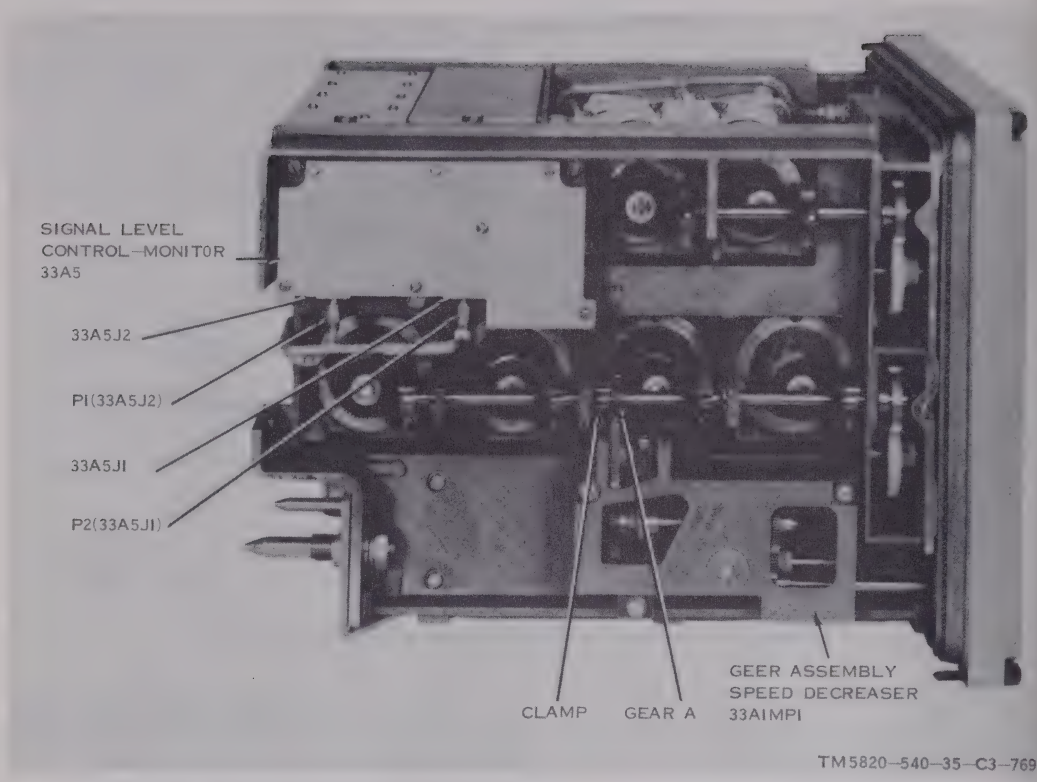


Figure 3-53. Band II receiver RF head, right side view.

Equipment	Common name
Adapter-Connector UG-29B/U.	
Cable Assembly, Radio Frequency CMC 456-931.	
Cable Assembly, Special Purpose, Electrical CMC 456-921.	

b. Operational Check.

(1) Disconnect plug P3 (33A2A1J1) from 33A2A1J1 on frequency multiplier 33A2A1 (fig. 3-49).

(2) Connect the test equipment as shown in figure 3-54.

(3) Set the AC POWER switch to ON and tune the receiver to channel 699. The output power level at P3 (33A2A1J1) should be +17 dbm ±2.5 db (power meter indication of +7 dbm ±2 db).

(4) Set the RCVR CHANNEL control to channel 700. The power meter indication should not change.

(5) Set the AC POWER switch to OFF. If the indications in (3) and (4) above are not within the specified limits, replace receiver RF head.

3-80. Frequency Multiplier 33A2A1

a. Test Equipment Required.

Equipment	Common name
Wattmeter, AN/URM-98	Power meter
Attenuator Fixed Empire Devices AT-75-10.	
Adapter-Connector, Omni Spectra 21010.	Adapter-connector OS21010
Adapter-Connector UG-29B/U.	

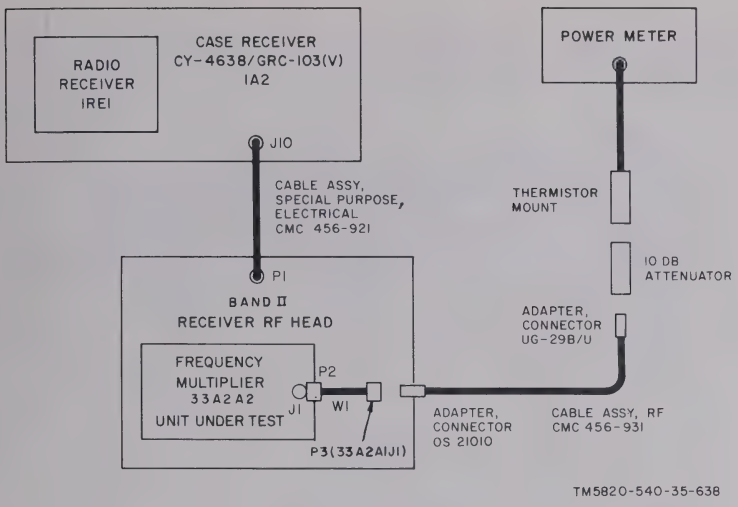


Figure 3-54. Frequency multiplier 33A2A2 operational check, test setup.

Equipment	Common name
able Assembly, Radio Frequency CMC 456-931.	
able Assembly, Special Purpose, Electrical CMC 456-921.	

b. Operational Check.

(1) Disconnect plug P2 (33A2FL1J1) from 2A2FL1J1 on filter bandpass 33A2FL1 (fig. -49).

(2) Connect the test equipment as shown in gure 3-55.

(3) Set the AC POWER switch to ON and ne the receiver to channel 699. The output ower level at P2 (33A2FL1J1) should be +10.5 bm ±1.5 db (power meter indication of .5 dbm ±1.5 db).

(4) Set the RCVR CHANNEL control to hannel 700. The power meter indication should ot change.

(5) Set the AC POWER switch to OFF. If he indications in (3) and (4) above are not ithin the specified limits, replace the receiver F head.

-81. Bandpass Filter 33A2FL1

a. Test Equipment Required.

Equipment	Common name
Vattmeter, AN/URM-98	Power meter
ttenuator Fixed Empire Devices AT-75-10.	10 db attenuator

Equipment	Common name
Adapter-Connector, Omni Spectra 21010.	Adapter-connector OS21010
Adapter-Connector UG-29B/U.	
Cable Assembly, RF CMC 456-931.	
Cable Assembly, Special Purpose, Electrical CMC 456-921.	

b. Operational Check.

(1) Disconnect plug P1 (33A7J2) from 33A7J2 of frequency mixer stage 33A7 (fig. 3-56).

(2) Connect the test equipment as shown in figure 3-57.

(3) Set the AC POWER switch to ON and tune the receiver to channel 699. The output power level at P1 (33A7J2) should be between +7 dbm and +12 dbm (power meter indication between —3 dbm and +2 dbm).

(4) Set the RCVR CHANNEL control to channel 700. The power meter indication should not change.

(5) Set the AC POWER switch to OFF. If the indications in (3) and (4) above are not within the specified limits, replace the receiver RF head.

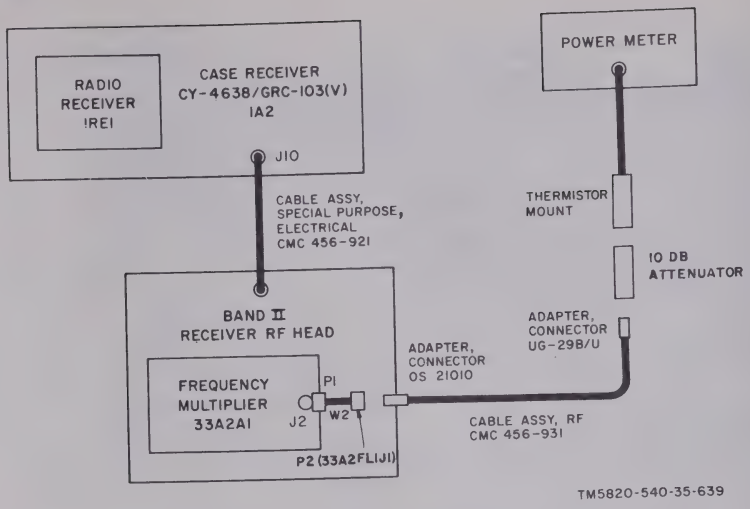


Figure 3-55. Frequency multiplier 33A2A1 operational check, test setup.

3-82. Intermediate Frequency Amplifier 33AR1

a. Test Equipment Required.

Equipment	Common name
Generator, Signal AN/USM-44A.	Signal generator No. 1.
Wattmeter, AN/URM-98	Power meter
Adapter-Connector, Omni Spectra 21170.	Adapter-connector OS21170
Adapter-Connector UG-201A/U.	
Cable Assembly, RF CG-3573/U (4.8 in.)	
Cable Assembly, RF GMC 335-058.	
Cable Assembly, RF CG-409H/U (3 ft).	
Cable Assembly, Special Purpose, Electrical CMC 456-921.	

b. Operational Check.

(1) Remove frequency mixer stage 33A7 as explained in paragraph 3-97. (Connector 33A1W1J8 (fig. 3-56) is now exposed).

(2) Disconnect plug 33A1W1A1P2 from 33AR1J1 on intermediate frequency amplifier 33AR1 (fig. 3-56).

(3) Connect the test equipment as shown in figure 3-58.

(4) Set the frequency of signal generator No. 1 to 30 MHz at an output level of —55 dbm.

(5) Set the receiver AC POWER switch to ON. The power meter should indicate between —20 dbm and —5 dbm.

(6) Set the receiver AC POWER switch to OFF. If the indication obtained in (5) above is outside the specified limits, replace intermediate frequency amplifier 33AR1. Refer to paragraph 3-96 for replacement procedures.

3-83. Frequency Mixer Stage 33A7

a. Test Equipment Required.

Equipment	Common name
Generator, Signal SG-340A/G.	Signal generator No. 2
Wattmeter, AN/URM-98	Power meter
Adapter-Connector, Omni Spectra 21010.	Adapter-connector OS21010
Adapter-Connector, Omni Spectra 21170.	Adapter-connector OS21170
Cable Assembly, RF CG-3573/U (4.8 in.) (2 required).	
Cable Assembly, RF CMC 456-931.	
Cable Assembly, Special Purpose, Electrical CMC 456-921.	

b. Operational Check.

(1) Disconnect plug P2 (33A7J1) from 33A7J1 on frequency mixer stage 33A7 (fig 3-56).

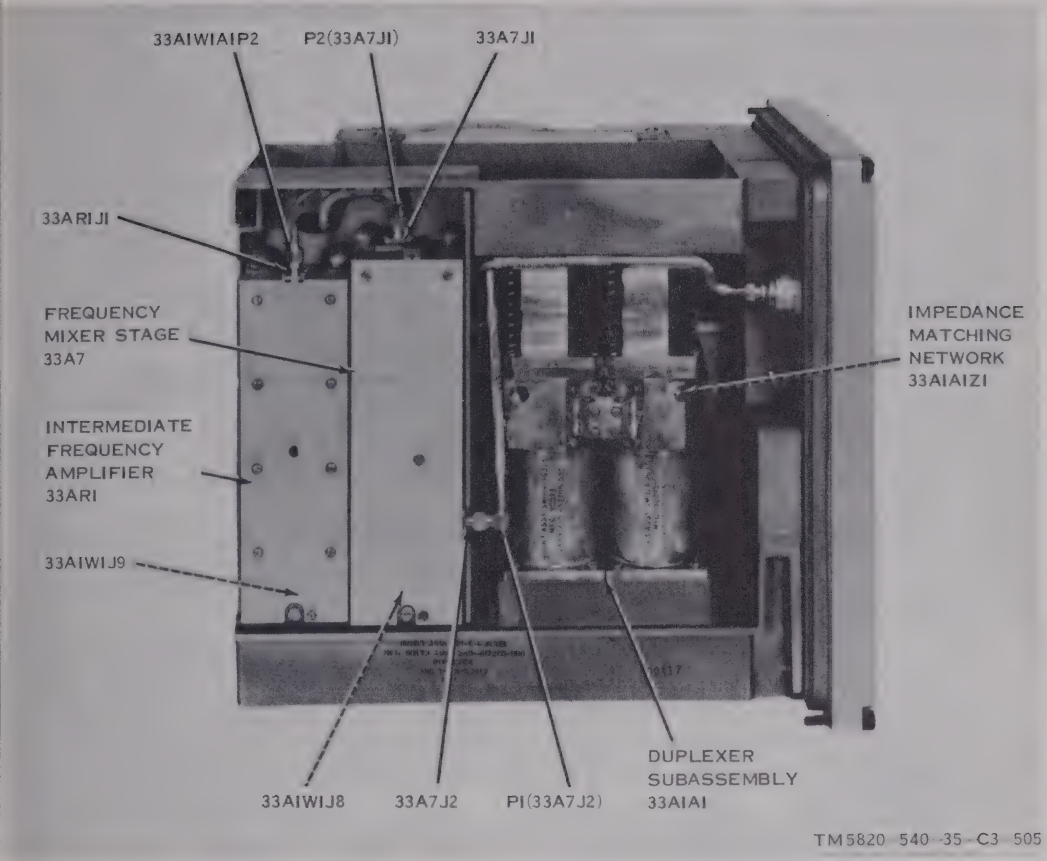


Figure 3-56. Band II receiver RF head, bottom view.

(2) Disconnect plug 33A1W1A1P2 from 33AR1J1 on intermediate frequency amplifier 33AR1.

(3) Connect the test equipment as shown in figure 3-59.

(4) Tune the receiver to channel 624.

(5) Set the frequency of signal generator No. 2 to 512 MHz at an output level of —50 dbm.

(6) Set the receiver AC POWER switch to ON. The power meter should indicate between —20 dbm and —5 dbm.

(7) If the indication obtained in (6) above is outside the specified limits replace frequency mixer stage 33A7 as described in paragraph 3-97.

3-84. Power Supply 33PS1 Deleted.

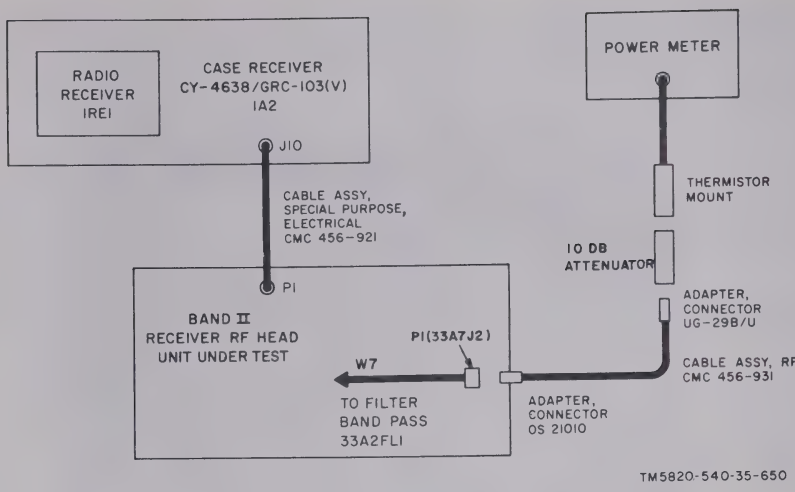


Figure 3-57. Bandpass filter 33A2FL1 operational check, test setup.

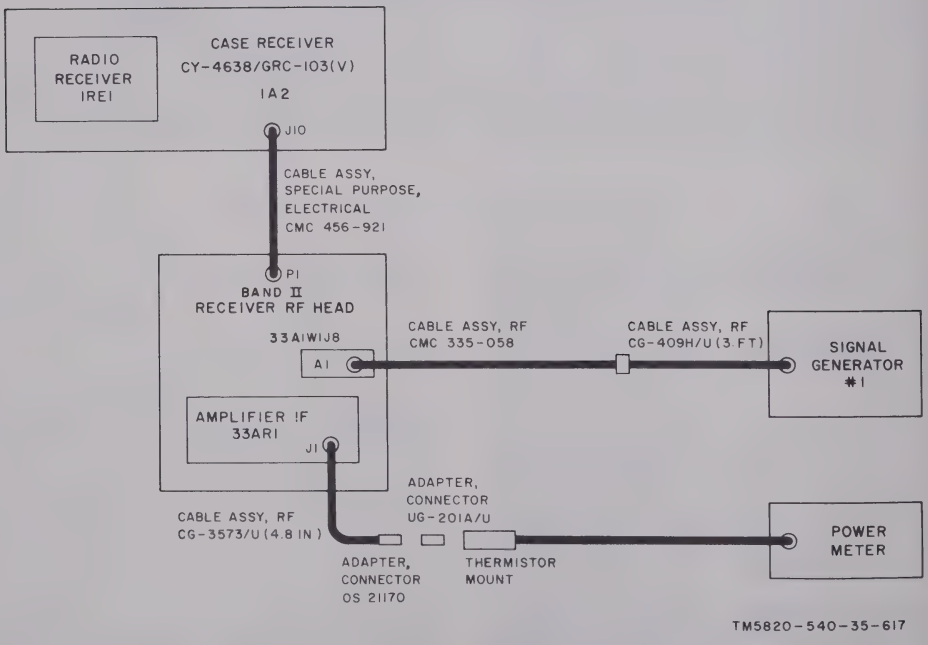


Figure 3-58. Intermediate frequency amplifier 33AR1 operational check, test setup.

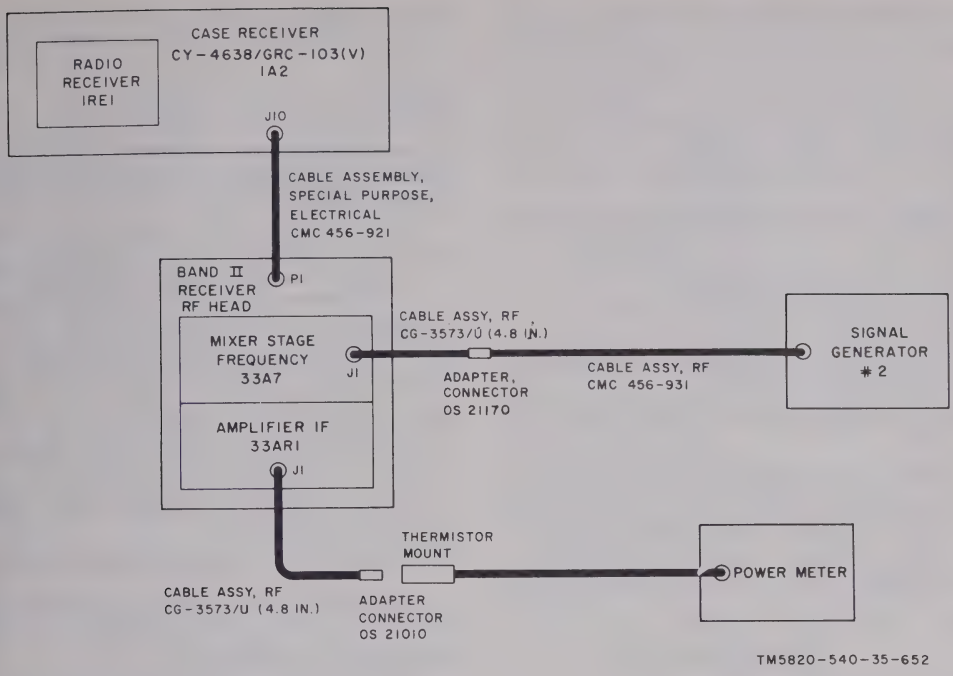


Figure 3–59. Frequency mixer stage 33A7 operational check, test setup.

3–85. Voltage Control Assembly 33A1A2

Deleted

3–86. Control-Indicator 33A4

a. Test Equipment Required.

Equipment	Common name
Multimeter TS-352B/U	Multimeter
Cable Assembly, Special Purpose, Electrical CMC 456-922.	
Cable Assembly, Special Purpose, Electrical CMC 456-921.	

b. Operational Check.

(1) Loosen the screws securing plug P1 (33A1W1J5) to chassis connector 33A1W1J5 and disconnect the plug (fig. 3–49).

(2) Set the RCVR CHANNEL control to channel 564.

(3) Using the multimeter, check for the

correct resistance between the following pins of P1 (33A1W1J5) as shown in the chart below.

Pins	Resistance
1 and 14	Infinity
2 and 14	Infinity
3 and 14	Infinity
4 and 14	Infinity
5 and 14	Infinity
6 and 14	Infinity
7 and 14	Infinity
8 and 14	Infinity
9 and 14	Infinity
10 and 14	Infinity
11 and 14	Infinity
12 and 14	Zero

(4) Set the RCVR CHANNEL control to channel 563.

(5) Using the multimeter, check for correct resistance between the following pins of P1 (33A1W1J5) as shown in the chart below.

Pins	Resistance
1 and 14	Infinity
2 and 14	Zero
3 and 14	Zero
4 and 14	Zero
5 and 14	Zero
6 and 14	Zero
7 and 14	Zero
8 and 14	Zero
9 and 14	Zero
10 and 14	Zero
11 and 14	Zero
12 and 14	Infinity

(6) Remove control-indicator 33A4 from the transmitter RF head as described in chapter 6 TM 11–5820–540–12.

(7) Connect plug P1 (33A1W1J5) to chassis connector 33A1W1J5 using cable CMC 456–922.

(8) Remove the four screws securing the control-indicator cover and remove the cover.

(9) Connect the receiver RF head to the receiver case using cable CMC 756–921 and set the AC POWER switch to ON.

(10) Set the control indicator to channel 699.

(11) Check the voltage at pin 13 of P1 (33A1W1J5) using the multimeter. The multimeter should indicate zero.

(12) Set the control-indicator to channel 700.

(13) Check the voltage at pin 13 of P1 (33A1W1J5) using the multimeter. The indication should be +26 volts dc.

(14) Set the AC POWER switch to OFF. Reinstall the control indicator cover. If abnormal indications are obtained in either (3), (5), (11) or (13) above, replace control-indicator 33A4. Refer to chapter 6, TM 11–5820–540–12 for replacement procedures.

Section V. MODULE REMOVAL AND REPLACEMENT PROCEDURES FOR BAND II RF HEADS

3–87. General

When trouble has been localized to a module of the radio set, replace the defective part as described in paragraphs 3–89 to 3–99. Before installing a replacement module, always check connectors for bent or damaged pins. Make sure the multipin connectors are properly mated and pressed home before tightening the mounting screws: Whenever difficulty is encountered in mating connectors, remove the module and inspect the connectors for damage.

3–88. Additional Equipment Required

In addition to the equipment mentioned in paragraph 3–42, the following tool is required to tighten RF connectors.

Description	Manufacturer's No.	Qty
Torque Wrench 9 in.-lb, Open End 5/16".	Commercial	1

3–89. Replacement of Control-Indicator 37A2

Replacement of control-indicator 37A2 is covered in chapter 6, TM 11–5820–540–12.

3–90. Replacement of Low-Pass Filter 37AR1A1FL1

a. Place the transmitter RF head right-hand side up and locate low-pass filter 37AR1A1FL1 (fig. 3–44).

b. Disconnect the two electrical plugs, P2 (37AR1A1FL1J1) and P1 (37AR1A1FL1J2) from their mating connectors (fig. 3–44).

c. Loosen the green-circled mounting screws that secure 37AR1A1FL1 to the chassis. Remove 37AR1A1FL1.

d. To install the 37AR1A1FL1 replacement module, position the module over the two mounting holes and tighten the mounting screws. Connect plugs P1 (37AR1A1FL1J2) and P2 (37AR1A1FL1J1) to their respective mating connectors.

3–91. Replacement of RF Power Monitor 37AR1A2

a. Place the transmitter RF head top side up and locate RF power monitor 37AR1A2 (fig. 3–44).

b. On the front panel of the transmitter RF head, loosen and remove the hexagonal nut that secures the PWR OUT connector to the front panel.

c. Disconnect plug P2 (37AR1A2J1) from 37AR1A2J1 (fig. 3–44).

d. Disconnect plug P1 (37AR1A1W1J4) from connector 37AR1A1W1J4 (fig. 3–42).

e. Remove the four red-circled mounting screws that secure RF power monitor 37AR1A2 to its bracket and remove the module.

f. To install the 37AR1A2 replacement module, slide connector J2 of the RF power monitor into the PWR OUT opening in the front panel and secure the hexagonal nut. Secure 37AR1A2 to its mounting bracket with four screws.

NOTE

The PWR OUT connector must be well-secured before tightening the 37AR1A2 mounting screws.

g. Connect plug P2 (37AR1A2J1) to 37AR1A2J1. Connect plug P1 (37AR1A1W1J4) to 37AR1A1W1J4 on the chassis and secure with two screws.

3–92. Replacement of Voltage Regulator Assembly 37AR1A1A1

a. Place the transmitter RF head right-hand side up.

b. Locate the voltage regulator assembly 37AR1A1A1 (fig. 3–44). Loosen and remove the four green-circled mounting screws. Pull the module up, carefully disengaging the connector.

c. To install the replacement module, carefully engage the connector of the module with the chassis connector by pushing the module straight down.

d. Tighten the four green-circled screws.

3–93. Replacement of Control-Indicator 33A4

Replacement of control-indicator 33A4 is covered in chapter 6, TM 11–5820–540–12.

3–94. Replacement of Frequency Multiplier 33A2A2

a. Place the receiver RF head top side up and locate frequency multiplier 33A2A2 (fig. 3–49).

b. Disconnect plug P2 (33A2A2J1) from 33A2A2J1 of frequency multiplier 33A2A2.

c. Loosen three green-circled mounting screws and carefully lift the module, disengaging it from the chassis connector.

d. To install the 33A2A2 replacement module, position the module over three mounting holes and carefully press home the connector.

e. Tighten the three mounting screws and connect the plug P2 (33A2A2J1) to 33A2A2J1.

3–95. Replacement of Signal Level Control-Monitor 33A5

a. Place the receiver right-hand side up and locate signal level control-monitor 33A5 (fig. 3–53).

b. Disconnect P1 (33A5J2) and P2 (33A5J1) from their mating connectors.

c. Loosen three green-circled mounting screws and carefully lift the module, disengaging it from the chassis connector.

d. To install the 33A5 replacement module, position the module over the mounting holes and carefully press home the connector.

e. Tighten the mounting screws and connect plugs P1 (33A5J2) and P2 (33A5J1) to 33A5J2 and J1 respectively.

3–96. Replacement of Intermediate Frequency Amplifier 33AR1

a. Place the receiver RF head bottom side up and locate intermediate frequency amplifier 33AR1 (fig. 3–56).

b. Disconnect plug 33A1W1A1P2 from 33AR1J1.

c. Loosen the three green-circled mounting screws and carefully lift the module, disengaging it from the chassis connector.

d. To install the replacement module, position the module over the mounting holes and carefully press home the connector.

e. Tighten the three mounting screws and reconnect plug 33A1W1A1P2 to 33AR1J1.

3-97. Replacement of Frequency Mixer Stage 33A7

a. Place the receiver RF head bottom side up and locate frrquency mixer stage 33A7 (fig. 3-56).

b. Disconnect plugs P1 (33A7J2) and P2 (33A7J1) from 33A7J2 and 33A7J1 respectively.

c. Loosen the three green-circed mounting screws and carefully lift the module, disengaging it from the chassis connector.

d. To install the replacement module, position the module over the mounting holes and carefully press home the connector.

e. Tighten the three mounting screws and reconnect P1 (33A7J2) and P2 (33A7J1) to 33A7J2 and 33A7J1 respectively.

3-98. Replacement of Power Supply 33PS1

Deleted.

3-99. Replacement of Low-Pass Filter 33FL1

a. Place the receiver RF head rear side up. Locate low-pass filter 33FL1 (fig. 3-49).

b. Disconnect plugs P1 (33FL1J2) and P2 (33FL1J1) from their respective connectors.

c. Place the receiver RF head bottom side up and remove intermediate frequency amplifier 33AR1 as explained in paragraph 3-96.

d. Remove the two mounting screws for 33FL1 which are located on the chassis under the IF amplifier.

e. To install the 33FL1 replacement module, place the module on the mounting holes and tighten the two screws from the other side of the chassis.

f. Replace intermediate frequency amplifier 33AR1 as explained in paragraph 3-96.

g. Connect plugs P1 (33FL1J2) and P2 (33FL1J1) to their respective connectors.

Section VI. TROUBLESHOOTING (BAND III)

3-100. General

This section contains the systematic troubleshooting procedure required to sectionalize a fault in the radio set and to trace the fault to the defective module or part. Meter readings may help in locating faults without the help of test equipment or measuring circuits. Operational tests frequently indicate the general location of trouble and in many instances help in determining the nature of the fault. The operational check, loop testing procedure and the troubleshooting charts contained in TM 11-5820-540-12 are suitable starting points. The modified loop test procedure, troubleshooting charts and signal substitution procedures enable direct support personnel to quickly localize the faulty module. Replacement of one or more suspected defective modules may be a quick and effective method of repairing a radio set in emergency conditions.

3-101. Additional Test Equipment Required

In addition to the test equipment listed in paragraph 3-2, the following equipment is required for Band III radio set maintenance.

a. Test Equipment.

Equipment	Common name	Qty
Generator, Signal SG-340A/G.	Signal Generator No. 2	1
Attenuator Fixed Empire Devices AT-75-10.	10 db attenuator	1
Attenuator Fixed Empire Devices AT-75-20.	20 db attenuator	1

b. Connectors.

Connector	Qty
Adapter-connector, Omni Spectra 21020 (type N male to OSM female).	2
Adapter-connector, Omni Spectra 21010 (type N female to OSM female).	2
Adapter-connector, Omni Spectra 21170 (type BNC female to OSM female).	1
Adapter-connector UG-29B/U (type N female to N female).	2

c. Cable Assembly, Radio Frequency.

Cable No.	Connector type
CG-3573/U (4.8 in.) (2 required).	OSM male to OSM male

Cable No.	Connector type
G-3444/U (3 ft 6 in)	Type C male to type C male.

d. Special Tool.

Wrench, torque 9 in.-lb, open end 5/16".

3-102. Loop Test Procedure

Refer to paragraph 3-4.

3-103. Transmitter Troubleshooting

CAUTION

The transmitter RF head when extended must be air-cooled during tests; a cooling fan must be pointed toward the power amplifier tubes at all times. If a cooling fan is not available the transmitter RF head *must not be operated for longer than 5-minute periods.* Another alternative is to place the transmitter RF head back into the transmitter case while troubleshooting radio transmitter 5TR1.

a. General. The troubleshooting chart contains troubleshooting procedures for radio transmitter 5TR1 and the transmitter RF head. Paragraphs 3-105 through 3-111 contain test procedures for the transmitter RF head only. Refer to paragraphs 3-8 through 3-12 for test procedures for radio transmitter 5TR1. For more effective troubleshooting of the transmitter, remove the transmitter RF head and radio transmitter 5TR1 from the transmitter case. Remove the transmitter RF head dust cover. Connect the transmitter RF head to the transmitter case using CMC 456-918 extender cable and connect radio transmitter 5TR1 to the transmitter case using CMC 456-916 and CMC 456-917 extender cables. Connect the transmitter to a 115-volt, 47- to 420-Hz source and proceed to troubleshoot the transmitter.

CAUTION

The transmitter RF head PWR OUT connector must be connected to the dummy load during troubleshooting. Damage to the equipment will result if this is not done.

b. Transmitter Troubleshooting Chart.

Symptom	Probable cause	Checks and corrective measures
When AC POWER switch is set to ON/RESET centrifugal fan does not start, AC POWER and LOW POWER lamps do not light, buzzer does not sound.	*a.* Defective power supply 5TR1PS1 (fig. 3-1). *b.* Defective switch 5TR1A1CB1 (fig. 3-3).	*a.* Check for 115v ac at connector J3 (5TR1-PS1P1) pins 6 and 7 (para 3-8). If voltage is present, replace 5TR1PS1 (para 3-47). *b.* If voltage not present in *a* above, check for 115v ac at switch LINE and LOAD terminals. If indications are normal make wiring continuity checks.
28V and 12V metering reads negative, all other metering zero, LOW POWER and SYNC lamps light.	Short circuit	Check for short on 28v supply line (fig. 6-14, 8-2).
12V reads negative, 28V full scale, 600V high, DRIVER normal, all other metering zero. LOW POWER and SYNC lamps light.	Short circuit	Check for short on 12v supply line (figs. 6-14, 8-2).
All metering reads zero, all lamps are inoperative, centrifugal fan operates.	Short circuit	Check for short on 26v supply line (figs. 6-14, 8-2). Check for short on 600v supply line (figs. 6-14, 8-2).
28V normal or zero, 12V normal, DOUBLER, MULT, DRIVER and PWR OUT low, OSC high. LOW POWER and SYNC lamps light.	Open circuit	Check for open 28v supply (figs. 6-14, 8-2).
When AC POWER switch is set to ON/RESET, centrifugal fan does not start; AC POWER, LOW POWER, and OVERHEAT lamps light; buzzer sounds.	*a.* Defective centrifugal fan 5A2B1 (fig. 6-9). *b.* Defective power supply 5TR1PS1 (fig. 6-8).	*a.* Check for 140v ac at connector J5 (5A2B1P1) pins 1 and 2 (transmitter case). If voltage is present replace 5A2B1 (TM 11-5820-540-12, para 6-15*c*). *b.* (1) Check for 140v ac at power supply filter terminals FL5 and FL6 of

Symptom	Probable cause	Checks and corrective measures
		5TR1PS1 (fig. 3-2). If no voltag is present replace 5TR1PS1 (pa 3-47). (2) If voltage is present at FL5 and FL6 5TR1PS1 (fig. 3-2) but not pins 1 and 2 of connector J (5A2B1P1) (TM 11-5820-540-1 fig. 6-9) in the transmitter cas remove 115v ac power source a check for continuity between the two points.
6.1. When AC POWER switch is set to ON/RESET, centrifugal fan does not start. OVERHEAT lamp is not on. Buzzer may or may not sound. All other indications normal.	**a. Defective OVERHEAT lamp 5TR1A2A2DS4.** **b. Defective pressure differential monitor 5A2A2.**	**a. Change indicator lamp 5TR1A2A2DS4.** **b. Higher category maintenance required.**
7. Buzzer does not sound when an alarm lamp lights or goes out.	*a.* Defective buzzer 5TR1A1DS5 (fig. 3-3).	*a.* Check for 26v dc at buzzer terminals. voltage in present replace the buzz (para 3-49).
	b. Defective switch 5TR1A1S2 (fig. 3-3).	*b.* If voltage is not present at buzzer termin remove 115v ac power source and che for continuity from the buzzer negati terminal to pin 5 of connector J3 (5TR PS1P1) (fig. 3-1) and from the buzz positive terminal to pin 4 of 5TR1A1J If continuity is broken because of 5TR A1S2, higher category maintenance required.
	c. Defective alarm control (fig. 3-3).	*c.* If continuity is broken because of 5TR1A A2, replace 5TR1A1A2 board (para 3-4
8. SYNC light does not go out within 10 seconds after AC POWER switch is set to ON/RESET.	*a.* Defective synthesizer 5TR1A2 (fig. 3-3).	*a.* Extend the synthesizer (para 3-10) a check for 12v, 26v and 28v at J1 (X5TR A2P2) (fig. 3-3). If normal indications a obtained, replace synthesizer 5TR1 (para 3-45).
	b. Defective power supply 5TR1PS1 (fig. 3-1).	*b.* If indications in *a* above are abnorm check 5TR1PS1 (para 3-8). If abnorm indications are obtained replace 5TR1P (para 3-47.)
8.1. OVERHEAT lamp does not go off within 10 seconds after AC power switch is set to ON RESET.	**Defective pressure differential monitor.**	**Higher category maintenance required.**

Symptom	Probable cause	Checks and corrective measures
DRIVER metering greater than 100%.	Short circuit in voltage regulator assembly 38AR1A1A1 or RF amplifier 38AR1AR1 (fig. 3-62).	Replace voltage regulator assembly and two electron tubes. If indication becomes normal, replace one original tube. If the indication still remains normal, replace the other original tube. If indications still remain normal, then only the voltage regulator 38AR1A1 was shorted. If the indication after replacement of the tubes and voltage regulator assembly does not become normal, higher category of maintenance is required.
LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. PWR OUT position reads low.	*a.* Defective RF power monitor 38AR1A2 (fig. 3-62).	*a.* Measure power (25 watts nominal) at P2 (38AR1A2J1). If normal, check 38AR1A2 (para 3-110).
	b. Defective low pass filter 38AR1A1-FL1 (fig. 3-62).	*b.* If power indication at P2 (38AR1A2J1) is abnormal, measure the power (25 watts nominal) at 38AR1A1FL1J1. If normal, check 38AR1A1FL1 (para 3-109).
	c. Defective circulator 38AR1HY1 (fig. 3-64).	*c.* If abnormal indication is obtained in *b* above, measure the power (25 watts nominal) at 38AR1AR1J4 (fig. 8-2). If normal, check 38AR1HY1 (para 3-111).
	d. Defective radio frequency amplifier 38AR1AR1 (fig. 3-62).	*d.* If abnormal indication is obtained in *c* above, measure the power at 38A1J2 (para 3-106). If normal, higher category of maintenance is required.
LOW POWER light does not go	No output cathode regulation. De-	Remove transmitter 5TR1 and measure the

Symptom	Probable cause	Checks and corrective measures
out within 60 seconds after AC POWER switch is set to ON/RESET. PWR OUT position reads low, DRIVER position reads high.	fective power supply 5TR1PS1 (fig. 3-1) or voltage regulator assembly 38AR1A1A1 (fig. 3-62).	resistance from pin 30 of connector J8 (X5-TR1A1A1P3) (fig. 6-9) (transmitter case) to ground (approximately 12 ohms). If normal, replace 5TR1PS1 (para 3-47). If abnormal, check voltage regulator assembly 38AR1A1A1 (para 3-108).
LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. PWR OUT position reads low, DRIVER position reads low.	*a.* Defective power supply 5TR1PS1 (fig. 3-1) or voltage regulator assembly 38AR1A1A1 (fig. 3-62).	*a.* (1) Measure the power (3.5 watts minimum) at 38AR1AR1J3 (fig. 3-62). If normal check the voltage at TP2 and TP4 of 38AR1A1A1 (para 3-108). If normal, disconnect the transmitter RF head and measure the resistance between TP2 and TP4 of 38AR1A1A1 (should be 1.5 ohms approximately). (2) If voltage at TP2 and TP4 is abnormal check the output heater/output cathode circuit of 5TR1PS1 (para 3-8). (3) If 5TR1PS1 check is normal, check continuity of output heater/output cathode wiring between 5TR1PS1 and transmitter RF head (figs. 6-14, 8-2).
	b. Defective amplifier subassembly 38AR1AR1 (fig. 3-62).	*b.* If the power at 38AR1AR1J3 (para 3-107) is abnormal, higher category maintenance is required.
	c. No driver cathode regulation. Defective power supply 5TR1PS1 (fig. 3-1) or voltage regulator assembly 38AR1A1A1 (fig. 3-62).	*c.* Remove the radio transmitter 5TR1 from the case and measure the resistance from pin 29 of connector J8 (X5TR1A1-A1P3) to ground (34 ohms approximately). If normal, replace 5TR1PS1 (para 3-47). If abnormal, check voltage regulator assembly 38AR1A1A1 (para 3-108).
	d. Defective driver cathode/driver heater circuit.	*d.* Measure the power at 38A1J2 (para 3-106). If normal, check the voltage across TP1 and TP3 of voltage regulator assembly 38AR1A1A1 (para 3-108). If normal, disconnect the transmitter RF head and measure resistance between TP1 and TP3 of voltage regulator assembly 38AR1A1A1 (should be 1.5 ohm approximately). If voltage at TP1 and TP3 is abnormal, check the DRIVER HEATER/DRIVER CATHODE circuit of 5TR1PS1 (para 3-8). If 5TR1PS1 check is normal, check the continuity of the DRIVER HEATER/DRIVER CATHODE wiring between 5TR1PS1 and transmitter RF head (figs. 6-14, 8-2).
	e. Defective RF amplifier 38AR1AR1 (fig. 3-62).	*e.* If driver cathode/driver heater circuit is normal, higher category maintenance is required.
At channel 1280 and above or channel 1279 and below LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. PWR OUT position reads low, DRIVER position reads low and MULT position reads low.	*a.* Defective amplifier frequency multiplier 38A1 (fig. 3-62). *b.* Defective wiring	*a.* Check the output of 38A1 (para 3-106). *b.* Check the continuity of 26V UNREG and 28V REG wiring between 5TR1PS1 and transmitter RF head (figs. 6-14, 8-2).
Same as 14 above but at all channels.	*a.* Defective wiring	*a.* Measure power at amplifier frequency multiplier 38A1J1 (2.5 watts minimum). If

Symptom	Probable cause	Checks and corrective measures
		abnormal, check for continuity fro 38A1J1 to pin A2 of J11 (X5TR1A4P (figs. 6–14, 8–2).
	b. Defective amplifier frequency multiplier 5TR1A4 (fig. 3–3).	*b.* If the wiring continuity check in *a* above normal, replace 5TR1A4 (para 3–46).
15. LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. DRIVER position reads low, MULT position reads low, DOUBLER position reads low.	*a.* Defective amplifier-frequency multiplier 5TR1A4 (fig. 3–3).	*a.* Measure the power at pin A1 of J11 (X TR1A4P1) (para 3–10). If it is norm check 5TR1A4 (para 3–11).
	b. Defective wiring	*b.* Check for −28v at pin of J11 (X5TR1A4P Check for ground at pin 17 of J11 (X5T 1A4P1) with the transmitter RF he connected.
16. LOW POWER light does not go out within 60 seconds after AC POWER switch is set to ON/RESET. DRIVER position reads low, MULT position reads low, DOUBLER position reads low, OSC position reads low.	*a.* Defective electrical-frequency synthesizer 5TR1A2 (fig. 3–3).	*a.* Check synthesizer 5TR1A2 (para 3–10).
	b. Defective wiring	*b.* Check inputs to 5TR1A2 at J1 (X5TR1A P2) (fig. 6–14). pin 1 +28v dc pin 3 0v pin 2 +12v dc pin 37 +28v dc
17. SYNC alarm does not go out within 10 seconds after AC POWER switch is set to ON/RESET.	*a.* Defective synthesizer 5TR1A2 (fig. 3–3).	*a.* Check synthesizer 5TR1A2 (para 3–10).
	b. Defective power supply 5TR1PS1 (fig. 3–1).	*b.* Check power supply 5TR1PS1 (para 3–8
18. When AC POWER switch is set to ON/RESET, buzzer and centrifugal fan operate, LOW POWER and SYNC alarm lights come on, DRIVER metering is low, all other metering reads zero.	Defective power supply 5TR1PS1 (fig. 3–1).	Check voltage reuglator amplifier 5TR1PS1A of power supply 5TR1PS1 (para 3–8).
19. No communication. Metering and LOW POWER and SYNC alarms may or may not indicate normal.	Synthesizer is off frequency due to—	
	a. Defective synthesizer 5TR1A2	*a.* Check synthesizer (para 3–10).
	b. Defective wiring	*b.* Check wiring from control-indicator 38 to the synthesizer (figs. 6–14, 8–

3–104. Receiver (Band III) Troubleshooting

a. General. The troubleshooting chart contains troubleshooting procedures for radio receiver 1RE1 and the receiver RF head. Paragraphs 3–112 through 3–122 contain test procedures for the receiver RF head only. Refer to paragraphs 3–32 through 3–39 for test procedures for radio receiver 1RE1. For more effective troubleshooti of the receiver, remove the receiver RF head a radio receiver 1RE1 from the receiver ca Remove the receiver RF head dust cover. Conn the radio receiver 1RE1 to the receiver case usi CMC 456–919 and CMC 456–920 extender cabl Connect the receiver to a 115-volt, 47- to 420- source and proceed to troubleshoot the receiv

b. Receiver Troubleshooting Chart.

Symptom	Probable cause	Checks and corrective measures
1. With AC POWER switch set to ON, there are no meter indications and no alarms.	Defective switch 1RE1A1CB1 (fig. 3–32).	Check for 115v ac at switch LINE and LO terminals (fig. 3–32). If switch is normal, m wiring continuity checks (fig. 6–29).
2. Buzzer does not sound when any alarm lamp lights or goes out.	Defective buzzer 1RE1A1DS5 (fig. 3–29).	Check for 26v dc at buzzer terminals (fig. 3– If voltage is present, replace buzzer (p 3–57). If voltage is not not present, m wiring continuity checks (fig. 6–29).
3 AC POWER switch will not stay on.	Short circuit	Make resistance checks on −12v dc, +12v and +26v dc lines to isolate short (fi 6–29, 8–7).
4. LOW SIGNAL alarm is on; RCVR SIG metering reads low.	*a.* Defective power monitor 34A3 or duplexer subassembly 34A1A1 (fig. 3–76).	*a.* Inject a signal at —65 dbm receive f quency into P1 (34A1A1J2) (fig. 3– If the alarm clears, higher category maintenance is required.

Symptom	Probable cause	Checks and corrective measures
	b. Defective signal level control-monitor 34A5 (fig. 3-69).	*b.* If the alarm condition remains, inject signal into P1 (34A5J2) (fig. 3-73). If the alarm clears, replace signal level control-monitor 34A5 (para 3-131).
	c. Defective low-pass filter 34FL1 (figs. 3-69).	*c.* If the alarm condition remains, inject the signal into P1 (34FL1J2) (fig. 3-69). If the alarm clears, replace low-pass filter 34FL1 (para 3-135).
	d. Defective frequency mixer stage 34A7 **(fig 3-76).**	*d.* If the alarm condition remains, remove frequency mixer stage 34A7 (para 3-133) and feed a signal of 30 MHz at −35 dbm into pin A1 of 34A1W1J8 (fig. 3-76). If alarm clears frequency mixer stage 34A7 **is defective. Check frequency mixer stage 34A7 (para 3-119).**
	e. Defective intermediate frequency amplifier 34AR1 (fig. 3-76).	*e.* If alarm remains inject a 30 MHz signal at a level of −35 dbm into 34A1W1A1P2 (fig. 3-76). If alarm clears, replace intermediate frequency amplifier 34AR1 (para 3-132).
	f. Local oscillator off frequency due to —.	
	(1) Defective synthesizer 1RE1A2 (fig. 3-32).	(1) Check synthesizer (para 3-33).
	(2) Defective wiring	(2) Check wiring from control indicator 33A4 to J3 (X1RE1A2P2) (figs. 6-29, 7-7).
LOW SIGNAL alarm, RCVR SIG reading low; MULT reading low.	Defective frequency multiplier group 34A2 (fig. 3-76).	Check the output power level at P1 (34A7J2) (para 3-117). If abnormal, replace receiver RF head.
SYNC alarm and/or LOW SIGNAL alarm, RCVR SIG reading low, MULT reading low, OSC reading low.	Defective synthesizer 1RE1A2 (fig. 3-32).	Check supply voltages at J3 (X1RE1A2P2). If normal, change synthesizer 1RE1A2 (para 3-56). If abnormal, check wiring (fig. 6-29).

-105. Control-Indicator 38A2

a. Test Equipment Required.

Equipment	Common name
ultimeter TS-352B/U	Multimeter
able Assembly, Special Purpose, Electrical CMC 456-922.	
able Assembly, Special Purpose, Electrical CMC 456-918.	

b. Operational Checks.

(1) Loosen the two screws securing plug P1 38AR1A1W1J3) to chassis connector 3AR1A1W1J3 (fig. 3-60). Disconnect P1 from 3AR1A1W1J3.

(2) Set the XMTR CHANNEL control to nannel 1648.

(3) Using the multimeter, check for correct esistance between the following pins of P1 38AR1A1W1J3) as shown in the chart below.

Pins	Resistance
1 and 14	Infinity
2 and 14	Infinity
3 and 14	Infinity
4 and 14	Infinity
5 and 14	Infinity
6 and 14	Infinity
7 and 14	Infinity
8 and 14	Infinity
9 and 14	Infinity
10 and 14	Infinity
11 and 14	Infinity
12 and 14	Zero

(4) Set the XMTR CHANNEL control to channel 1647.

(5) Using the multimeter, check for correct resistance between the following pins of P1 (38AR1A1W1J3) as shown in the chart below.

Pins	Resistance
1 and 14	Infinity
2 and 14	Zero

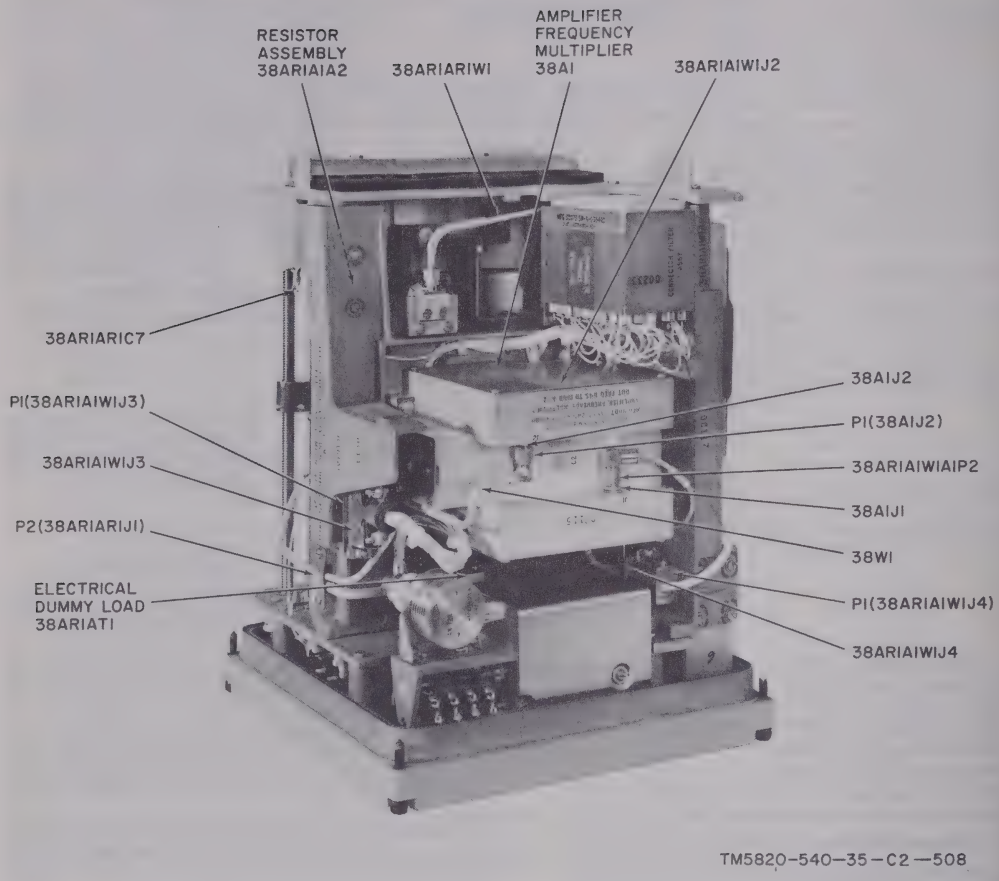


Figure 3-60. Band III transmitter RF head, top view.

Pins	Resistance
3 and 14	Zero
4 and 14	Zero
5 and 14	Zero
6 and 14	Zero
7 and 14	Zero
8 and 14	Zero
9 and 14	Zero
10 and 14	Zero
11 and 14	Zero
12 and 14	Infinity

(6) Remove control indicator 38A2 from the transmitter RF head as described in chapter 6, TM 11-5820-540-12.

(7) Connect plug P1 (38AR1A1W1J3) to chassis connector 38AR1A1W1J3 using cable CMC 456-922.

(8) Remove the four screws securing the control-indicator cover and remove the cover.

(9) Connect the transmitter RF head to the transmitter case using cable CMC 456-918 and set the AC POWER switch to ON/RESET.

(10) Set the control-indicator to channel 1279.

(11) Using the multimeter check the voltage at terminal 24 (pin 13 of P1). The multimeter should indicate zero volt.

(12) Set the control-indicator to channel 1280.

(13) Using the multimeter, check the voltage at terminal 24. The indication should be +26 volts dc.

(14) Set the AC POWER switch to OFF. Reinstall the control-indicator cover. If abnormal indications are obtained in either (3), (5), (11) or (13) above, replace control-indicator 38A2. Refer to chapter 6, TM 11-5820-540-12 for replacement procedures.

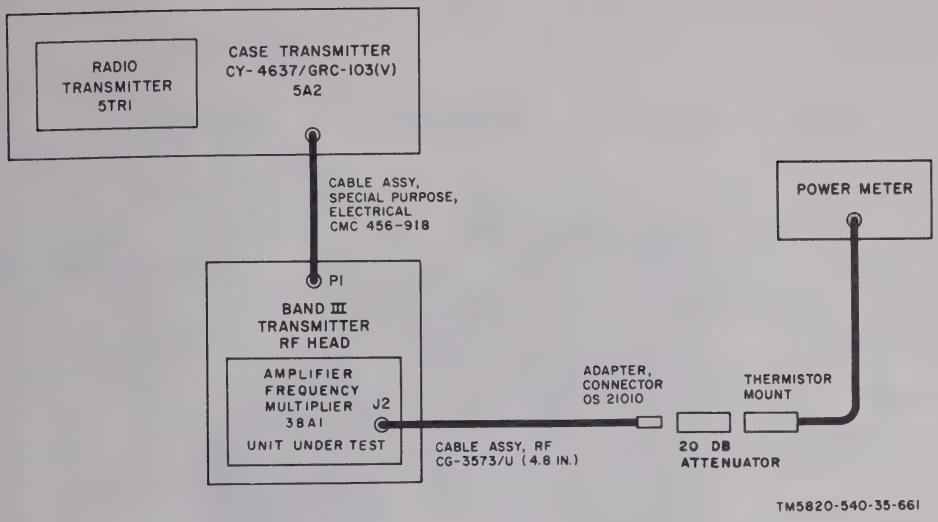


Figure 3-61. Amplifier-frequency multiplier 38A1 operational check, test setup.

-106. Amplifier-Frequency Multiplier 38A1

a. Test Equipment Required.

Equipment	Common name
attmeter AN/URM-98	Power meter
tenuator, Fixed 20-db Empire Devices AT-75-20.	20-db attenuator
ble Assembly, Special Purpose, Electrical CMC 456-918.	
ble Assembly, Radio Frequency CG-3573/U (4.8 in.).	
apter-Connector, Omni Spectra 21010.	Adapter-connector OS21010

b. Operational Check.

(1) Disconnect plug P1 (38A1J2) from 8A1J2 on amplifier-frequency multiplier 38A1 ig. 3-60).

(2) Connect test equipment as shown in gure 3-61.

(3) Set the XMTR CHANNEL and XMTR UNE controls to channel 1279.

(4) Set the transmitter AC POWER switch ON/RESET. The level at 38A1J2 should be 23 dbm minimum.

(5) Set the XMTR CHANNEL and XMTR UNE controls to channel 1280. The level at 8A1J2 should be +22 dbm minimum.

(6) Set the AC POWER switch to OFF. Replace transmitter RF head if abnormal indications are obtained in either (4) or (5) above.

3-107. Radio Frequency Amplifier 38AR1AR1

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM-120	Wattmeter
Cable Assembly, Special Purpose, Electrical CMC 456-918.	
Cable Assembly, Radio Frequency CMC 456-931 (2 required).	
Cable Assembly, Radio Frequency CG-3573/U (4.8 in.).	
Adapter-Connector, Omni Spectra 21010 (2 required).	Adapter-connector OS21010
Adapter-Connector UG-29B/U.	

b. Operational Check.

(1) Disconnect P2 (38AR1AR1J3) from 38AR1AR1J3 on radio frequency amplifier 38AR1AR1 (fig. 3-62).

(2) Connect the test equipment as shown in A, figure 3-63.

(3) Insert the coupler-detector CU-755/URM-120 into the wattmeter.

(4) Set the XMTR CHANNEL and XMTR TUNE control to channel 1280.

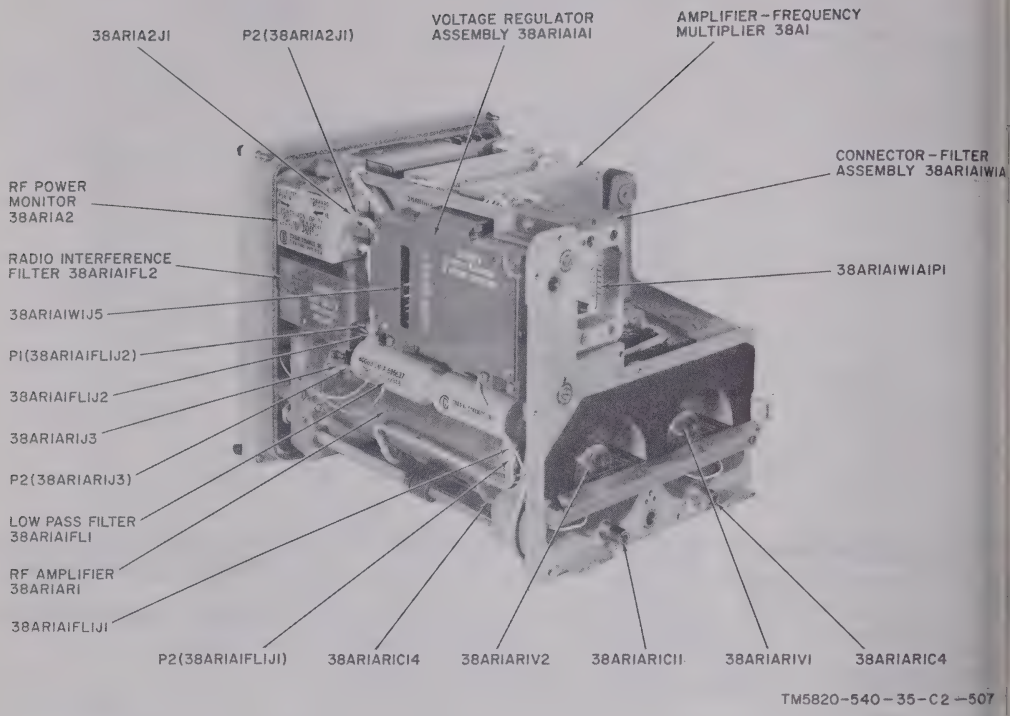


Figure 3-62. Band III transmitter RF head, side view.

(5) Set the transmitter AC POWER switch to ON/RESET and the meter switch to DRIVER. The wattmeter should indicate 3.5 watts minimum.

(6) Set the AC POWER switch to OFF.

(7) Reconnect plug P2 (38AR1AR1J3) to 38AR1AR1J3.

(8) Disconnect plug P2 (38AR1HY1J1) from 38AR1HY1J1 on circulator 38AR1HY1 (fig. 3-64).

(9) Connect the test equipment as shown in B, figure 3-63.

(10) Set the AC POWER switch to ON/RESET.

(11) Set the meter switch to PWR OUT. The wattmeter should indicate 32 watts.

(12) Set the AC POWER switch to OFF.

(13) Replace the transmitter RF head if a normal indications are obtained in (5) and (1 above.

3-108. Voltage Regulator Assembly 38AR1A1A1

a. Test Equipment Required.

Equipment	Common name
Multimeter TS-352B/U	Multimeter
Cable Assembly, Special Purpose Electrical CMC 456-918.	

b. Operational Check.

(1) Remove the transmitter RF head from tl case. Remove the dust cover from the RF hea

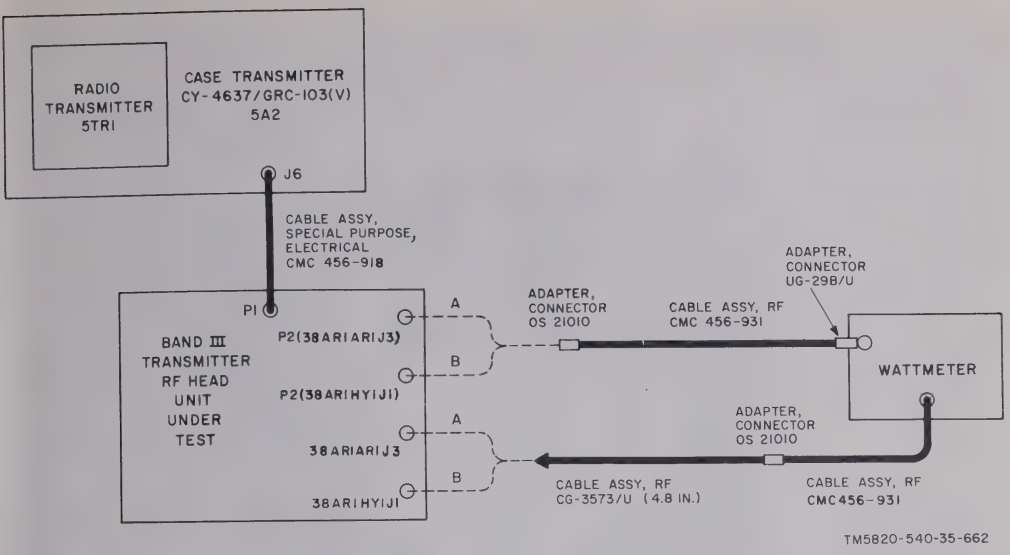


Figure 3–63. Radio frequency amplifier 38AR1AR1 operational check, test setup.

d locate voltage regulator assembly AR1A1A1 (fig. 3–62).

(2) Connect J6 on the transmitter case to AR1A1W1A1P1 on the transmitter RF head ing cable CMC 456–918.

(3) Set the XMTR CHANNEL and XMTR UNE controls to channel 1280.

(4) Set the AC POWER switch to ON/RE-ET.

(5) Set the meter switch to PWR OUT.

(6) Using multimeter, check for correct volt-ge between the following test points on the volt-ge regulator assembly as shown in the chart low.

Multimeter (+)	Multimeter (−)	Voltage
P4	TP2	6.3v dc±0.13v
P3	TP1	6.3v dc±0.13v
P4	TP5	13.8v dc±0.7v
P4	TP11	3.2v dc±1.5v
P3	TP10	3.2v dc±1.5v

(7) Remove voltage regulator assembly 8AR1A1A1 (para 3–128) and check the resist-nce between the following pins of P1.

Pins	Resistance (ohms ± 10%)
and 5	12
and 5	34
and 5	10M
and 6	270K

(8) Set the AC POWER switch to OFF. If abnormal indication is obtained in (6) above, replace voltage regulator assembly 38AR1A1A1. Refer to paragraph 3–128 for replacement procedures.

3–109. Low-Pass Filter 38AR1A1FL1

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM–120	Wattmeter
Cable Assembly, Special Purpose, Electrical CMC 456–918.	
Cable Assembly, Radio Frequency CG–3573/U (4.8 in.).	
Cable Assembly, Radio Frequency CMC 456–931 (2 required).	
Adapter-Connector, Omni Spectra 21020 (2 required).	Adapter-connector OS21020
Adapter-Connector UG–29B/U (3 required).	

b. Operational Checks.

(1) Disconnect plug P1 (38AR1A1FL1J2) from 38AR1A1FL1J2 on low-pass filter 38AR1A1FL1 (fig. 3–62).

(2) Connect the test equipment as shown in figure 3–65.

(3) Insert the coupler-detector CU–755/URM–120 into the wattmeter.

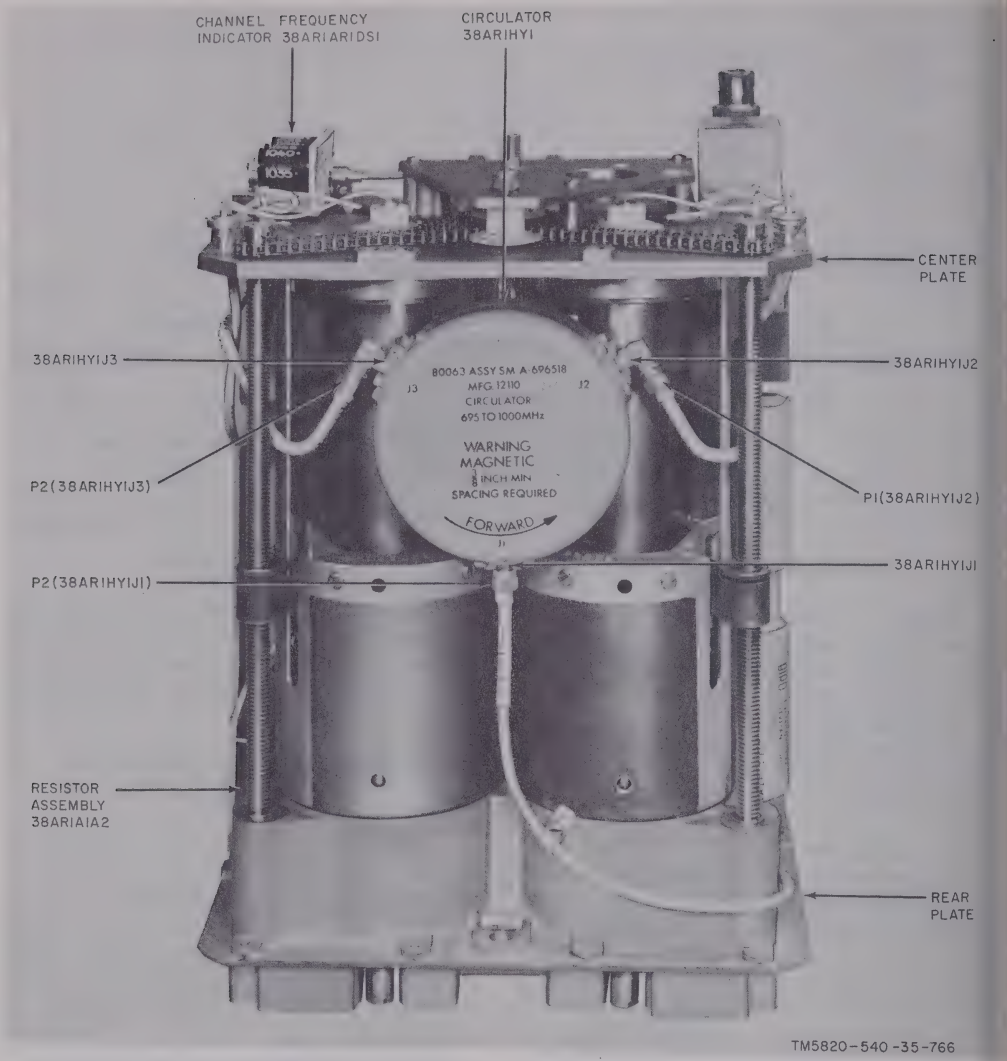


Figure 3-64. Band III transmitter RF head, bottom view.

(4) Set the XMTR CHANNEL and XMTR TUNE controls to channel 1280.

(5) Set the transmitter AC POWER switch to ON/RESET.

(6) Set the meter switch to PWR OUT. The wattmeter should indicate 25 watts minimum.

(7) Set the AC POWER switch to OFF. Replace low pass filter 38AR1A1FL1 if an abnormal indication is obtained in (6) above. Refer to paragraph 3-126 for replacement procedure.

3-110. RF Power Monitor 38AR1A2

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM-120 Cable Assembly, Radio Frequency CMC 456-931. Adapter-Connector UG-565A/U. Adapter-Connector UG-29B/U.	Wattmeter

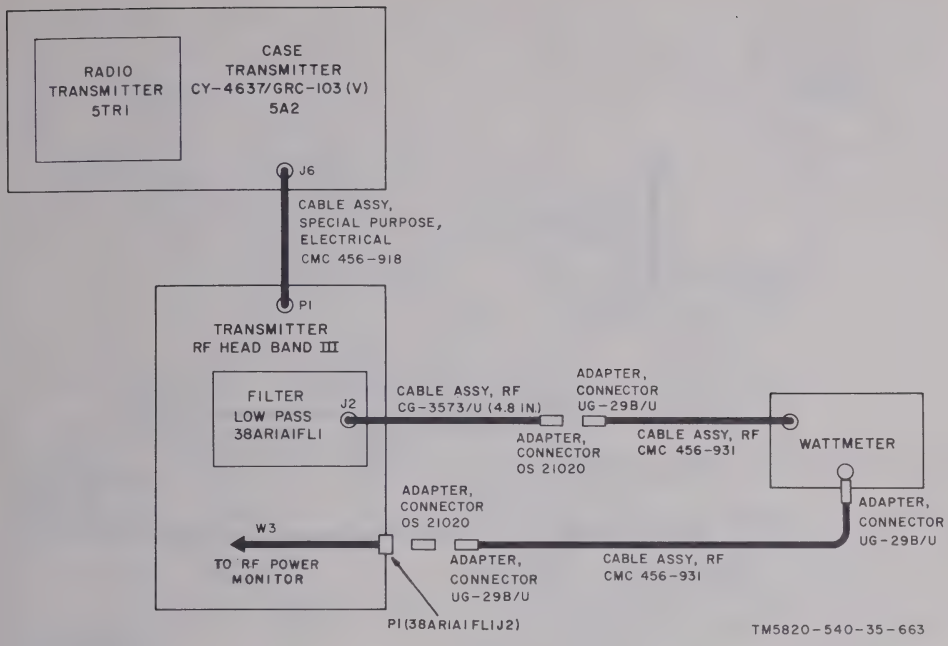


Figure 3-65. Low-pass filter 38AR1A1FL1 operational check, test setup.

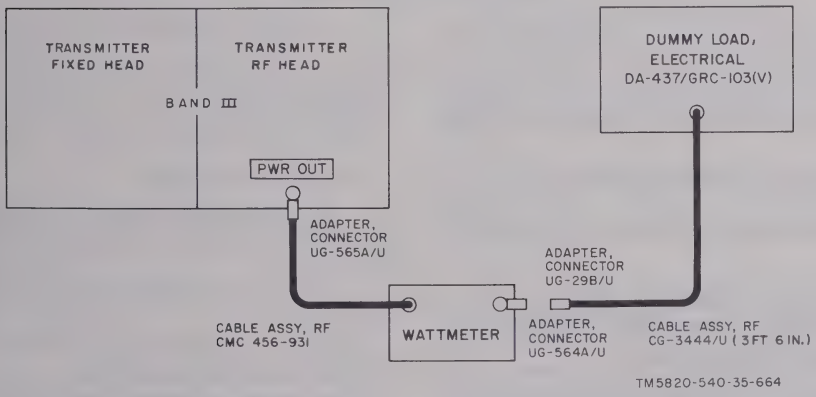


Figure 3-66. RF power monitor 38AR1A2 operational check, test setup.

Equipment	Common name
dapter-Connector UG-564A/U.	
ummy Load, Electrical DA-437/GRC-103(V).	
able Assembly, Radio Frequency CG-3444/U (3 ft 6 in.).	

b. Operational Check.

(1) Connect the test equipment as shown in figure 3-66.

(2) Insert the coupler-detector CU-755/URM-120 into the wattmeter.

(3) Set the XMTR CHANNEL and XMTR TUNE controls to channel 1280.

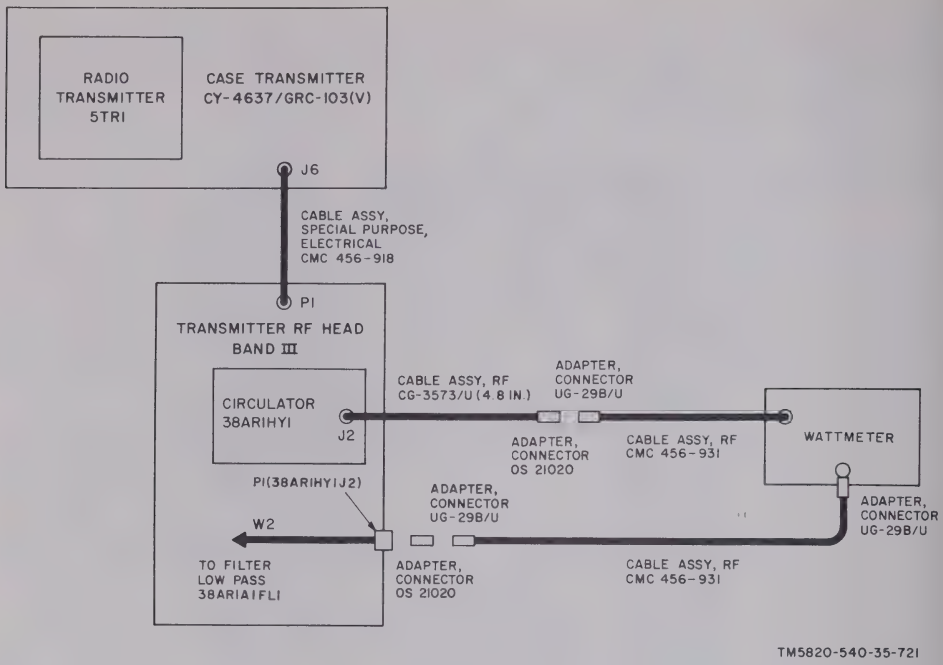


Figure 3–67. Circulator 38AR1HY1 and electrical dummy load 38AR1AT1 operational check, test setup.

(4) Set the transmitter AC POWER switch to ON/RESET.

(5) Set the transmitter meter switch to PWR OUT. The wattmeter should indicate 25 watts minimum.

(6) Set the AC POWER switch to OFF. If an abnormal indication is obtained, replace power monitor 38AR1A2 as described in paragraph 3–127.

3–111. Circulator 38AR1HY1 and Electrical Dummy Load 38AR1AT1

a. Test Equipment Required.

Equipment	Common name
Wattmeter, AN/URM-120	Wattmeter
Cable Assembly, Special Purpose, Electrical CMC 456-918.	
Cable Assembly, Radio Frequency CG-3573/U (4.8 in.).	
Cable Assembly, Radio Frequency CMC 456-931 (2 required).	
Adapter-Connector. Omni Spectra 21020 (2 required).	Adapter-connector OS21020
Adapter-Connector UG-29B/U (3 required).	

b. Operational Check.

(1) Disconnect plug P1 (38AR1HY1J2 from 38AR1HY1J2 on circulator 38AR1HY1 (fig 3–64).

(2) Connect the test equipment as shown i figure 3–67.

(3) Set the XMTR CHANNEL and XMT TUNE controls to channel 1280.

(4) Set the transmitter AC POWER switch t ON/RESET.

(5) Set the meter switch to PWR OUT. Th wattmeter should indicate 28 watts minimum.

(6) Set the AC POWER switch to OFF. I an abnormal indication is obtained in (5) abov replace the transmitter RF head.

3–112. Duplexer Subassembly 34A1A1 and RF Power Monitor 34A3

a. Test Equipment Required.

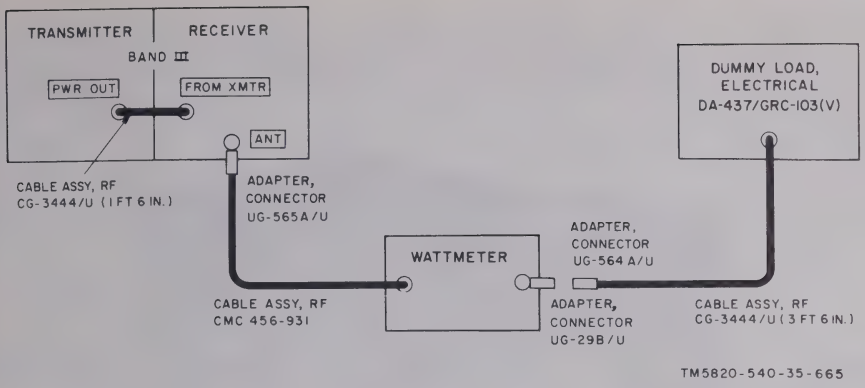


Figure 3-68. Duplexer subassembly 34A1A1 (transmit) operational check, test setup.

Equipment	Common name
ttmeter AN/URM-120	Wattmeter
nerator, Signal SG-340A/G.	Signal generator No. 2
ltmeter, Electronic ME-30A/U.	VTVM
ad, 51 ohms CMC 335-053	Load, 51 ohms
apter-Connector UG-565A/U.	
apter-Connector UG-29B/U.	
apter-Connector UG-564A/U.	
apter-Connector UG-274/U.	
mmy Load, Electrical DA-437/GRC-103(V).	
apter-Connector, Omni Spectra 21010.	Adapter-connector OS21010
ble Assembly, Radio Frequency CMC 456-931.	
ble Assembly, Radio Frequency CMC 456-930.	
ble Assembly, Special Purpose, Electrical CMC 456-921.	
ble Assembly, Radio Frequency CG-3444/U (1 ft 6 in.).	
ble Assembly, Radio Frequency CG-3444/U (3 ft 6 in.).	

b. Operational Check—Transmit Path.

(1) Connect the test equipment as shown in gure 3-68.

(2) Insert the coupler-detector CU-755/RM-120 into the wattmeter.

(3) Set the XMTR CHANNEL and XMTR UNE controls to channel 1280.

(4) Set the transmitter AC POWER switch to ON/RESET. The wattmeter should indicate 13 watts minimum.

(5) Set the AC POWER switch to OFF. If an abnormal reading is obtained in (4) above, higher category of maintenance is required.

c. Operational Check—Receive Path.

(1) Disconnect plug P1 (34A1A1J2) (fig. 3-69) from 34A1A1J2 on duplexer 34A1A1.

(2) Connect the test equipment as shown in A, figure 3-70.

(3) Tune the receiver to channel 1390.

(4) Set the frequency of signal generator No. 2 to 895 MHz and adjust the output level until a reading of —50 dbm is obtained on the VTVM. Note the attenuator setting on signal generator No. 2.

(5) Reconnect plug P1 (34A1A1J2) to 34A1A1J2.

(6) Connect the test equipment as shown in B, figure 3-70.

(7) Increase the output of signal generator No. 2 until a reading of —50 dbm is obtained on the VTVM. The output attenuator setting on signal generator No. 2 should not be more than 3 db lower than the setting noted in (4) above.

(8) If the indication in (7) above is not obtained, replace the receiver RF head.

3-113. Signal Level Control-Monitor 34A5

a. Test Equipment Required.

Equipment	Common name
Voltmeter, Electronic ME-30A/U.	VTVM
Generator, Signal SG-340A/G.	Signal generator No. 2.

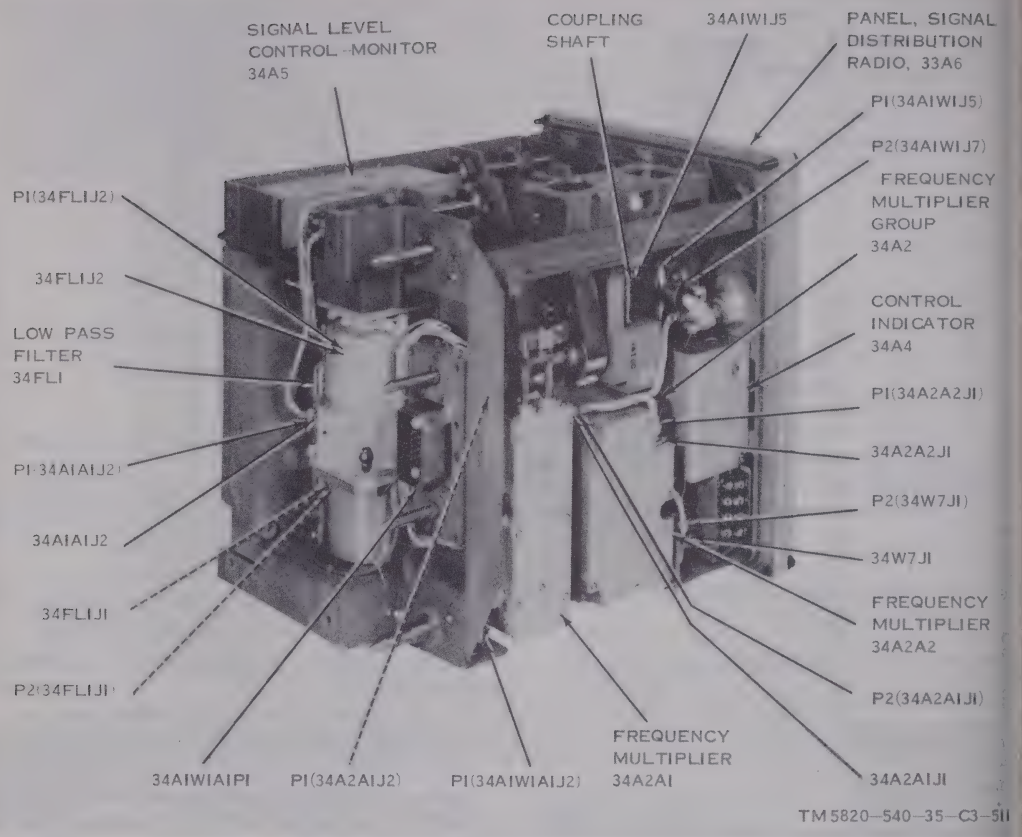


Figure 3-69. Band III receiver RF head, top and rear view.

Equipment	Common name
Load, 51 ohms CMC 335-053. Adapter-Connector, Omni Spectra 21010. Adapter-Connector UG-274/U. Cable Assembly, RF CMC 456-930. Cable Assembly, RF CMC 456-931. Cable Assembly, Special Purpose, Electrical CMC 456-921.	Load, 51 ohms Adapter-connector OS21010

b. Operational Check.

(1) Disconnect plug P1 (34A1A1J2) (fig. 3-69 from 34A1A1J2 on duplexer 34A1A1.

(2) Connect the test equipment as shown in A, figure 3-71.

(3) Tune the receiver to channel 1390 a the signal generator to 895 MHz.

(4) Set the AC POWER switch to ON.

(5) Increase the output level of signal gene ator No. 2 until the high signal alarm operat (buzzer may sound if not muted). The signal ge erator No. 2 level will be 0 dbm ± 10 dbm.

(6) Decrease the level of signal generat No. 2 until the VTVM indicates —50 dbm.

(7) Connect the test equipment as shown B, figure 3-71.

(8) The indication on VTVM should not higher than —49.25 dbm.

(9) Set the AC POWER switch to OFF.

(10) If the high signal alarm does not co on in (5) above, and/or the indication obtained (8) above is beyond the specified limit, the un

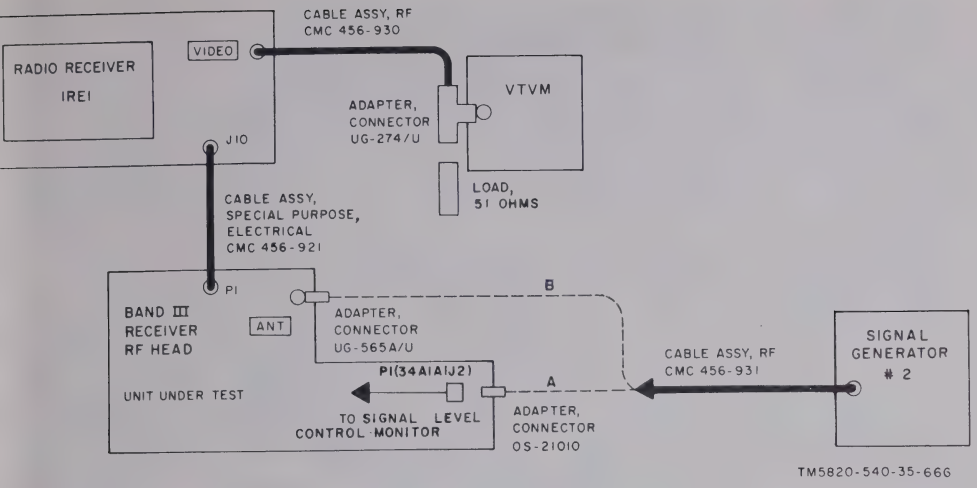


Figure 3-70. Duplexer subassembly 34A1A1 (receive) operational check, test setup.

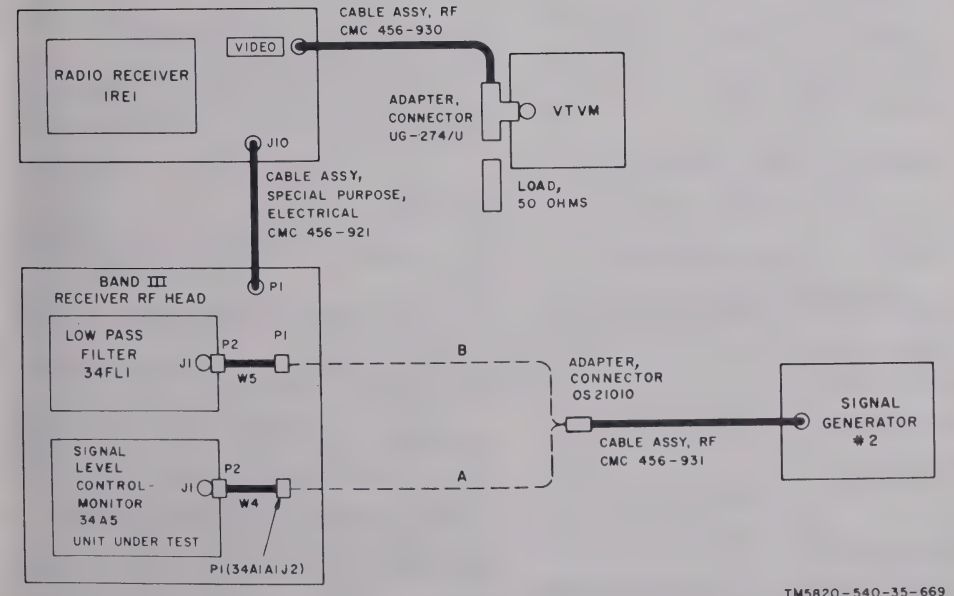


Figure 3-71. Signal level control-monitor 34A5 operational check, test setup.

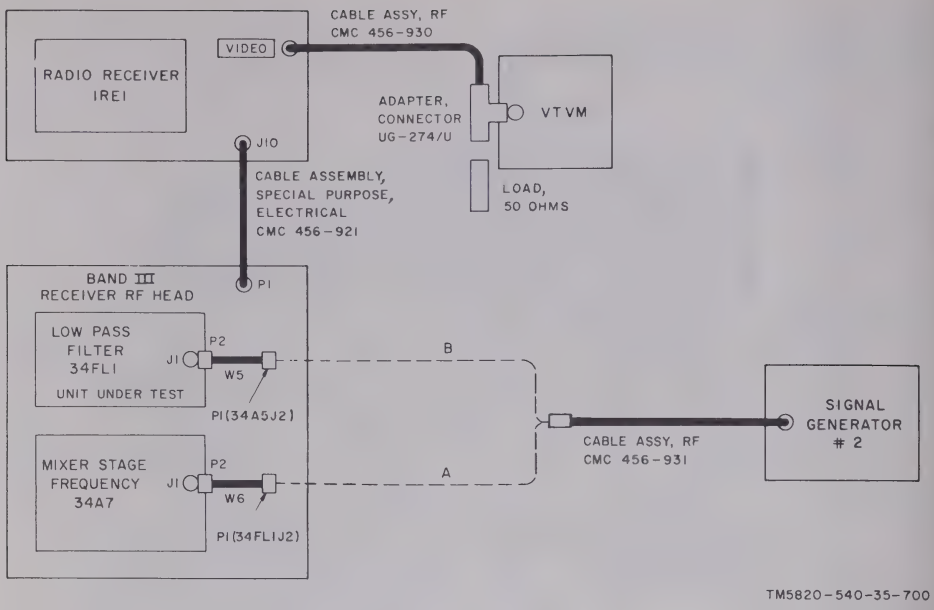


Figure 3-72. Low-pass filter 34FL1 operational check, test setup.

under test should be replaced. Refer to paragraph 3-131 for replacement procedures.

3-114. Low Pass Filter 34FL1

a. Test Equipment Required.

Equipment	Common name
Voltmeter, Electronic ME-30A/U.	VTVM
Generator, Signal SG-340A/G.	Signal generator No. 2.
Load, 51 ohms CMC 335-053	Load, 51 ohms
Adapter-Connector, Omni Spectra 21010.	Adapter-connector OS21010
Adapter-Connector UG-274/U	
Cable Assembly, RF CMC 456-930.	
Cable Assembly, RF CMC 456-931.	
Cable Assembly, Special Purpose, Electrical CMC 456-921.	

b. Operational Check.

(1) Disconnect plug P1 (34FL1J2) from 34FL1J2 on filter low pass 34FL1 (fig. 3-69).

(2) Connect the test equipment as shown in A, figure 3-72.

(3) Tune the receiver to channel 1390 an signal generator No. 2 to 895 MHz.

(4) Set the AC POWER switch to ON.

(5) Adjust the output level of signal gener tor No. 2 until a reading of —50 dbm is obtaine on the VTVM.

(6) Reconnect plug P1 (34FL1J2) t 34FL1J2.

(7) Disconnect plug P1 (34A5J2) (fig. 3-73 from 34A5J2 on signal level control monito 34A5.

(8) Connect the test equipment as shown i B, figure 3-72.

(9) The indication on the VTVM should no be lower than —50.5 dbm.

(10) If an abnormal indication is obtained i (9) above, replace 34FL1. Refer to paragrap 3-135 for replacement procedures.

3-115. Frequency Multiplier 34A2A2

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM-98	Power meter
Attenuator Fixed, Empire Devices AT-75-10.	10-db attenuator

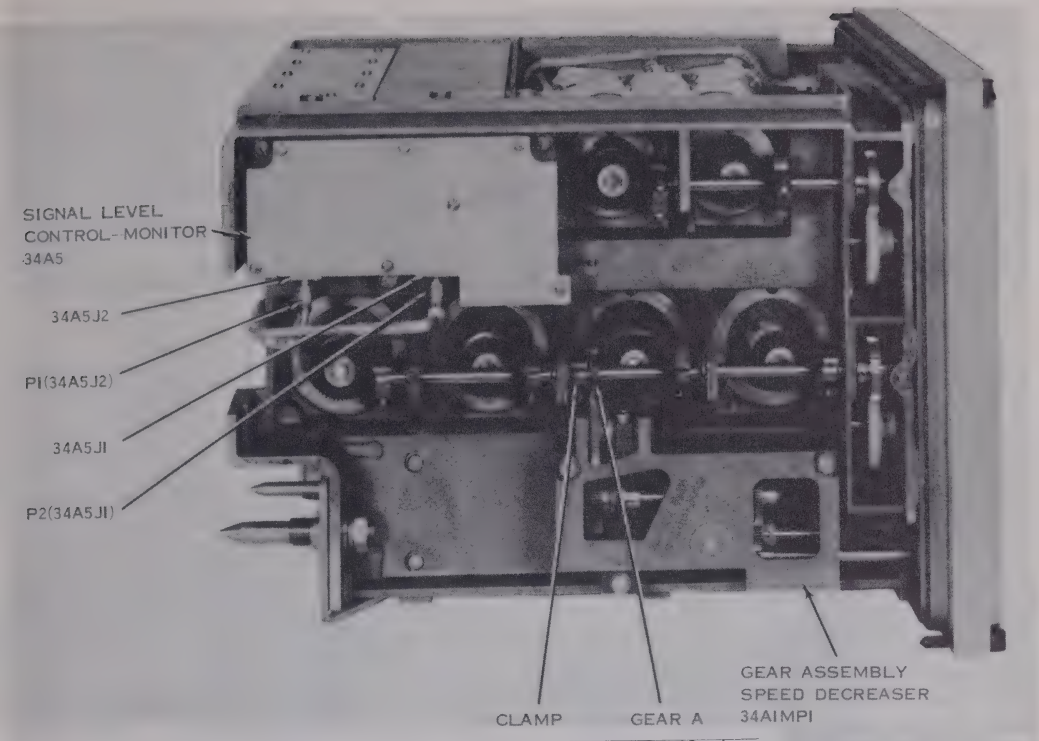


Figure 3-73. Band III receiver RF head, right side view.

Equipment	Common name
apter-Connector, Omni Spectra OS21010. apter-Connector UG-29B/U. ble Assembly, RF CMC 56-931. ble Assembly, Special Purpose, Electrical CMC 56 921.	Adapter-connector OS21010

b. Operational Check.

(1) Disconnect plug P2 (34A2A1J1) from A2A1J1 on frequency multiplier 34A2A1 (fig. 69).

(2) Connect the test equipment as shown in ure 3-74.

(3) Set the AC POWER switch to ON and ne the receiver to channel 1219. The output wer level at P2 (34A2A1J1) should be +7 dbm 2 db (power meter indication of —3 dbm ± 2 b).

(4) Set the RCVR CHANNEL control to annel 1220. The power meter indication should ot change.

(5) Set the AC POWER switch to OFF. If the indications in (3) and (4) above are not within the specified limits, replace receiver RF head.

3-116. Frequency Multiplier 34A2A1

a. Test Equipment Required.

Equipment	Co mmon name
Wattmeter AN/URM-98	Power meter
Attenuator Fixed Empire Devices AT-75-10.	10-db attenuator
Adapter-Connector, Omni Spectra 21010.	Adapter-connector OS21010
Adapter-Connector UG-29B/U.	
Cable Assembly, RF CMC 456-931.	
Cable Assembly, Special Purpose, Electrical CMC 456-921.	

b. Operational Check.

(1) Disconnect plug P1 (34A2A1J2) (fig. 3-69) from 34A2A1J2 of frequency multiplier 34A2A1.

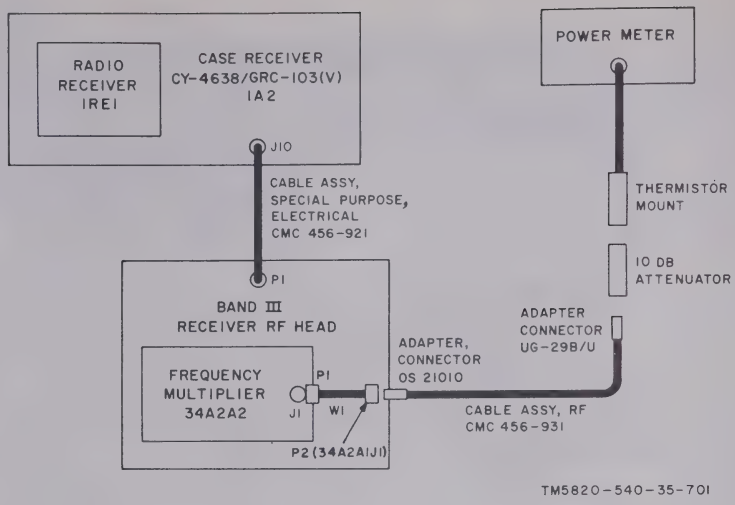


Figure 3-74. Frequency multiplier 34A2A2 operational check, test setup.

(2) Connect the test equipment as shown in figure 3-75.

(3) Set the AC POWER switch to ON and tune the receiver to channel 1219. The output power level at P2 (34A2FL1J1) should be +7 dbm ± 2 db (power meter indication of —3 dbm ± 2 db).

(4) Set the RCVR CHANNEL control to channel 1220. The power meter indication should not change.

(5) Set the AC POWER switch to OFF. If the indications in (3) and (4) above are no within the specified limits, replace the receive RF head.

3-117. Bandpass Filter 34A2FL1

a. Test Equipment Required.

Equipment	Common name
Wattmeter AN/URM-98	Power meter
Attenuator Fixed Empires Device AT-75-10.	10-db attenuator

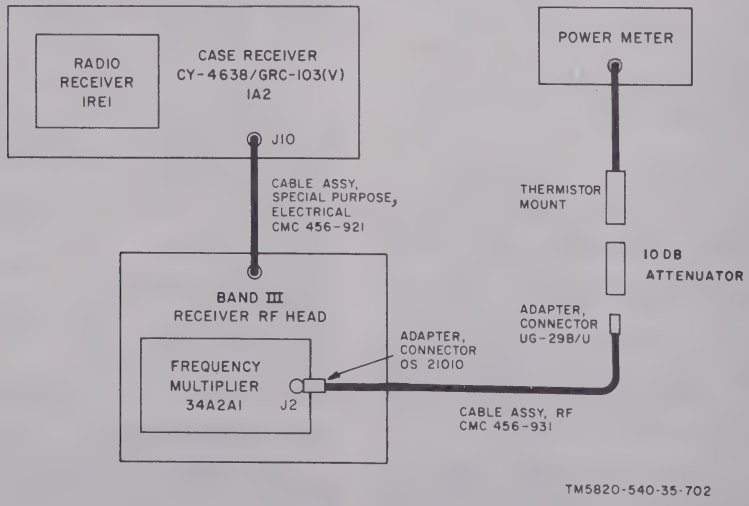


Figure 3-75. Frequency multiplier 34A2A1 operational check, test setup.

Equipment	Common name
Adapter-Connector, Omni Spectra 21010.	Adapter-connector OS21010
Adapter-Connector UG–29B/U.	
Cable Assembly, RF CMC 456–931.	
Cable Assembly, Special Purpose Electrical CMC 456–921.	

b. Operational Check.

(1) Disconnect plug P1 (34A7J2) from 34A7J2 of frequency mixer stage 34A7 (fig. 3–76).

(2) Connect the test equipment as shown in figure 3–77.

(3) Set the AC POWER switch to ON and tune the receiver to channel 1219. The output power level at P1 (34A7J2) should be +5 dbm ± 2 db (pwer meter indication of —5 dbm ± 2 db).

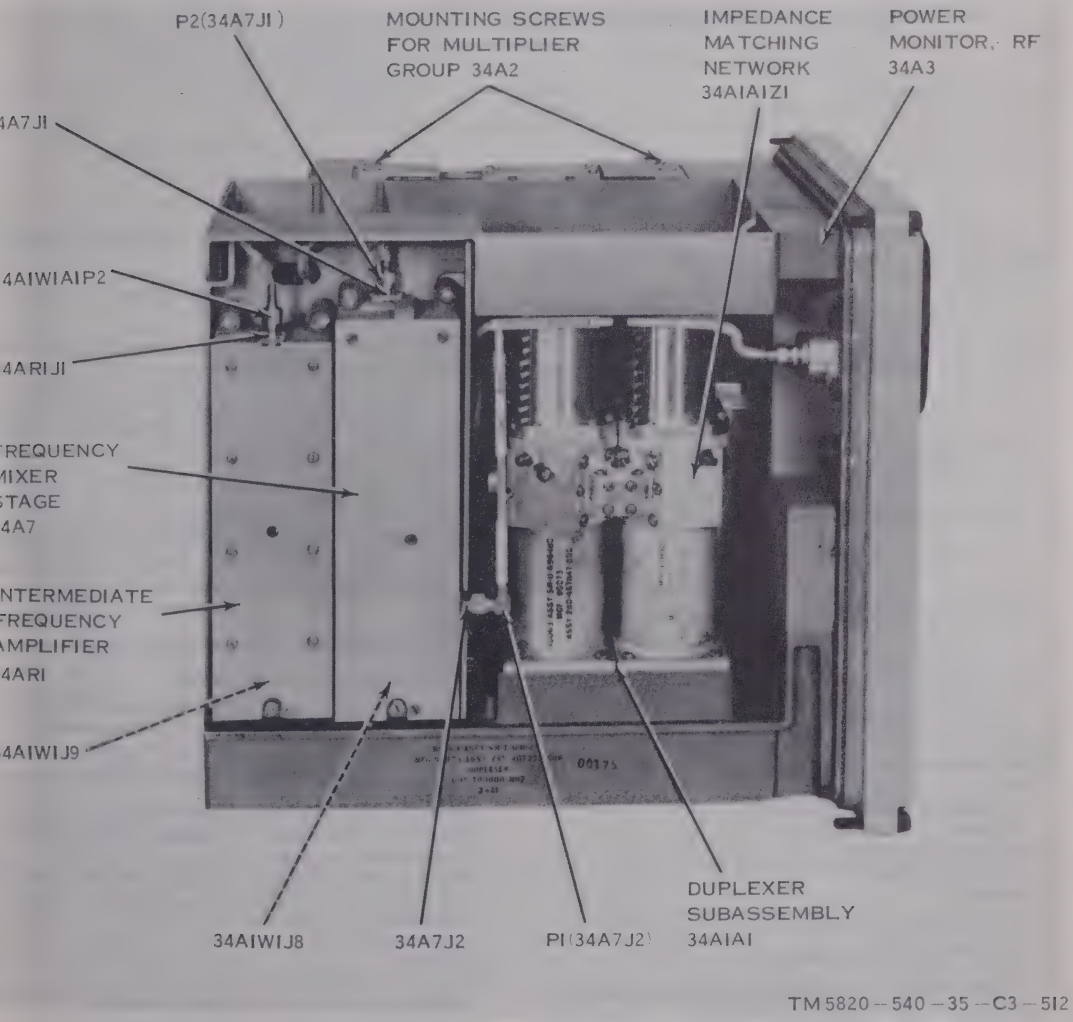


Figure 3–76. Band III receiver RF head, bottom view.

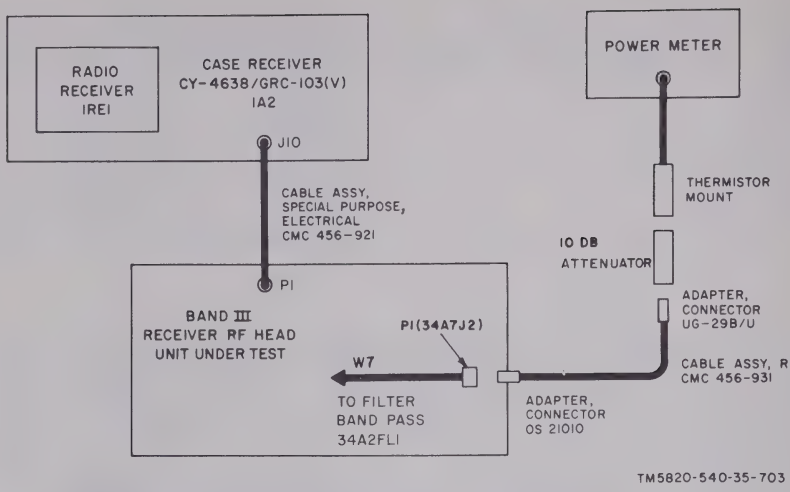


Figure 3-77. Bandpass filter 34A2FL1 operational check, test setup.

(4) Set the RCVR CHANNEL control to channel 1220. The power meter indication should not change.

(5) Set the AC POWER switch to OFF. If the indications in (3) and (4) above are not within the specified limits, replace the receiver RF head.

3-118. Intermediate Frequency Amplifier 34AR1

a. Test Equipment Required.

Equipment	Common name
Generator, Signal AN/USM-44A.	Signal generator No. 1.
Wattmeter, AN/URM-98	Power meter
Adapter-Connector, Omni Spectra 21170.	Adapter-connector OS21170
Cable Assembly, RF CG-3573/U (4.8 in.).	
Cable Assembly, RF CMC 335-058.	
Cable Assembly, RF CMC 456-930.	
Cable Assembly, Special Purpose, Electrical CMC 456-921.	

b. Operational Check.

(1) Remove frequency mixer stage 34A7 as explained in paragraph 3-133. (Connector 34A1W1J8 (fig. 3-76) is now exposed.)

(2) Disconnect plug 34A1W1A1P2 from 34AR1J1 on intermediate frequency amplifie 34AR1 (fig. 3-76).

(3) Connect the test equipment as shown i figure 3-78.

(4) Set the frequency of signal generator N 1 to 30 MHz at an output level of —55 dbm.

(5) Set the receiver AC POWER switch t ON. The power meter should indicate betwee —20 dbm and —5 dbm.

(6) Set the receiver AC POWER switch t OFF. If the indication obtained in (5) above i outside specified limits, replace intermediate fr quency amplifier 34AR1. Refer to paragrap 3-132 for replacement procedures.

3-119. Frequency Mixer Stage 34A7

a. Test Equipment Required.

Equipment	Common name
Generator, Signal SG-340A/G.	Signal generator No. 2.
Wattmeter, AN/URM-98	Power meter
Adapter-Connector, Omni Spectra 21170.	Adapter-connector OS21170
Adapter-Connector, Omni Spectra 21010.	Adapter-connector OS21010
Cable Assembly, RF CG-3573/U (4.8 in.) (2 required).	
Cable Assembly, RF CMC 456-931.	
Cable Assembly, Special Purpose, Electrical CMC 456-921.	

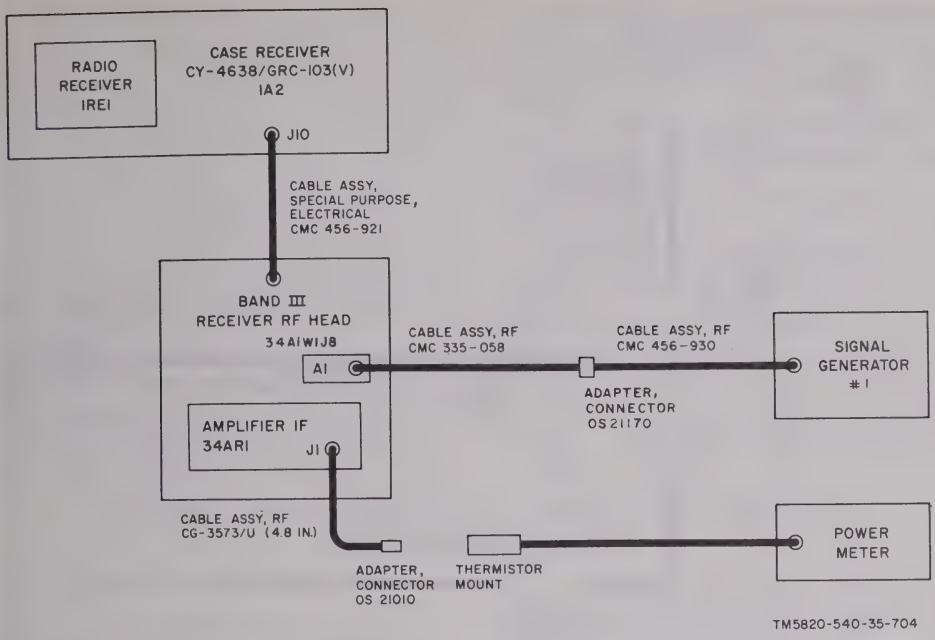


Figure 3-78. Intermediate frequency amplifier 34AR1 operational check, test setup.

b. Operational Check.

(1) Disconnect plug P2 (34A7J1) from A7J1 on frequency mixer stage 34A7 (fig. 76).

(2) Disconnect plug 34A1W1A1P2 from AR1J1 on intermediate frequency amplifier AR1.

(3) Connect the test equipment as shown in ure 3-79.

(4) Tune the receiver to channel 1390.

(5) Set the frequency of signal generator No. to 895 MHz at an output level of —50 dbm.

(6) Set the receiver AC POWER switch to N. The power meter should indicate between -20 dbm and —5 dbm.

(7) If the indication obtained in (6) above is utside specified limits, replace frequency mixer age 34A7 as described in paragraph 3-133.

-120. Power Supply 34PS1

Deleted.

-121. Voltage Control Assembly 34A1A2

Deleted.

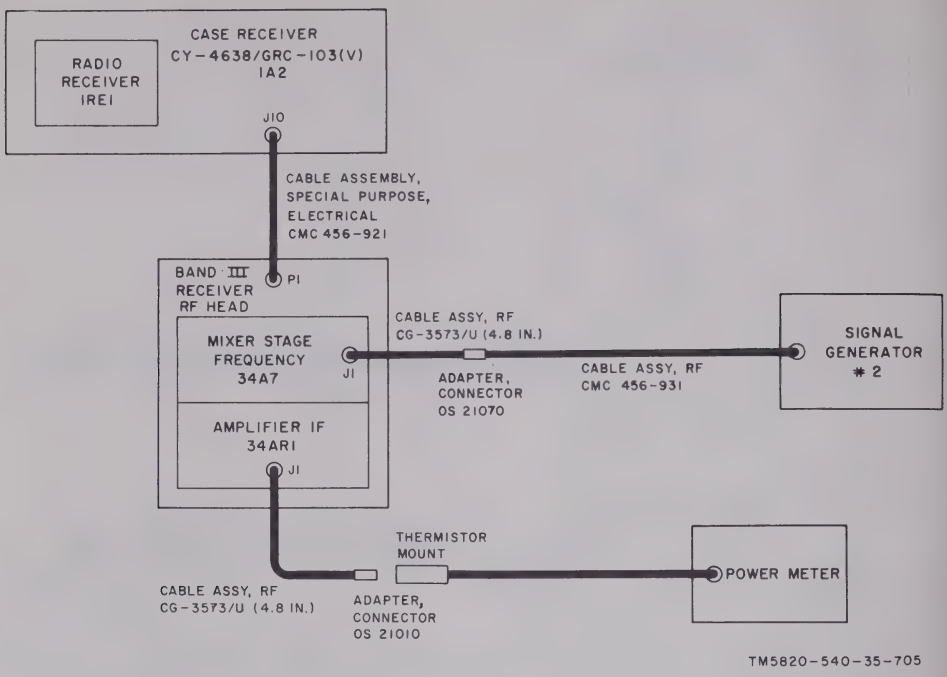


Figure 3-79. Frequency mixer stage 34A7 operational check, test setup.

3-122. Control-Indicator 34A4

a. Test Equipment Required.

Equipment	Common name
Multimeter TS-352B/U	Multimeter
Cable Assembly, Special Purpose, Electrical CMC 456-922.	
Cable Assembly, Special Purpose, Electrical CMC 456-921.	

b. Operational Check.

(1) Loosen the screws securing plug P1 (34A1W1J5) to chassis connector 34A1W1J5 and disconnect the plug (fig. 3-69).

(2) Set the RCVR CHANNEL control to channel 1588.

(3) Using the multimeter, check for the correct resistance between the following pins of P1 (34A1W1J5) as shown in the chart below:

Pins	Resistance
1 and 14	Infinity
2 and 14	Infinity
3 and 14	Infinity
4 and 14	Infinity
5 and 14	Infinity
6 and 14	Infinity
7 and 14	Infinity
8 and 14	Infinity
9 and 14	Infinity
10 and 14	Infinity
11 and 14	Infinity
12 and 14	Zero

(4) Set the RCVR CHANNEL control channel 1587.

(5) Using the multimeter, check for corre resistance between the following pins of P (34A1W1J5) as shown in the chart below:

Pins	Resistance
1 and 14	Infinity
2 and 14	Zero
3 and 14	Zero
4 and 14	Zero

Pins	Resistance
and 14	Zero
and 14	Zero
and 14	Zero
and 14	Zero
and 14	Zero
and 14	Zero
and 14	Zero
and 14	Infinity

(6) Remove control-indicator 34A4 from the ansmitter RF head as described in chapter 6, M 11–5820–540–12.

(7) Connect plug P1 (34A1W1J5) to chassis nnector 34A1W1J5 using cable CMC 456–922.

(8) Remove the four screws securing the ntrol-indicator cover and remove the cover.

(9) Connect the receiver RF head to the receiver fixed head using cable CMC 456–921 and set the AC POWER switch to ON.

(10) Set the control-indicator to channel 1219.

(11) Check the voltage at terminal 24 (pin 13 of P1) using the multimeter. The multimeter should indicate zero volt.

(12) Set the control-indicator to channel 1220.

(13) Check the voltage at terminal 24 using the multimeter. The indication should be +26 volts dc.

(14) Set the AC POWER switch to OFF. Reinstall the control-indicator cover. If abnormal indications are obtained in either (3), (5), (11) or (13) above, replace control-indicator 34A4. Refer to chapter 6, TM 11–5820–540–12 for replacement procedures.

Section VII. MODULE REMOVAL AND REPLACEMENT PROCEDURES FOR BAND III RF HEADS

-123. General

hen trouble has been localized to a module of e radio set, replace the defective part as scribed in paragraphs 3–125 through 3–135. fore installing a replacement module, always eck connectors for bent or damaged pins. Make re the multipin connectors are properly mated d pressed home before tightening the mounting rews. Whenever difficulty is encountered in ating connectors, remove the module and inspect e connectors for damage.

-124. Additional Equipment Required

addition to the equipment mentioned in para-aph 3–42, the following additional tool is quired to tighten RF connectors.

Description	Manufacturer's No.	Qty
rque Wrench 9 in. -lb, Open End 5/16".	Commercial	1

-125. Replacement of Control-Indicator 38A2

eplacement of control-indicator 38A2 is covered chapter 6, TM 11–5820–540–12.

-126. Replacement of Low-Pass Filter 38AR1A1FL1

a. Place the transmitter RF head right-hand de up and locate low-pass filter 38AR1A1FL1 ig. 3–62).

b. Disconnect the two RF leads, P2 (38AR1A1FL1J1) and P1 (38AR1A1FL1J2) from their mating connectors.

c. Loosen the green-circled mounting screws that secure 38AR1A1FL1 to the chassis. Remove 38AR1A1FL1.

d. To install the 38AR1A1FL1 replacement module, position the module over the two mounting holes and tighten the mounting screws. Connect plugs P1 (38AR1A1FL1J2) and P2 (38AR1A1FL1J1) to their respective mating connectors.

3–127. Replacement of RF Power Monitor 38AR1A2

a. Place the transmitter RF head top side up and locate RF power monitor 38AR1A2 (fig. 3–62).

b. On the front panel of the transmitter RF head, loosen and remove the hexagonal nut that secures the PWR OUT connector to the front panel.

c. Disconnect plug P2 (38AR1A2J1) from 38AR1A2J1.

d. Disconnect plug P1 (38AR1A1W1J4) from 38AR1A1W1J4 (fig. 3–60).

e. Remove the four red-circled mounting screws that secure RF power monitor 38AR1A2 to its bracket and remove the module.

f. To install the 38AR1A2 replacement module,

slide connector J2 of the power monitor into the PWR OUT opening in the front panel and secure the hexagonal nut. Secure 38AR1A2 to its mounting bracket with four screws.

NOTE

The PWR OUT connector hexagonal nut must be well-secured before tightening the 38AR1A2 mounting screws.

g. Connect plug P2 (38AR1A2J1) to 38AR1A2J1. Connect plug P1 (38AR1A1W1J4) to 38AR1A1W1J4 on the chassis and secure with two screws.

3–128. Replacement of Voltage Regulator Assembly 38AR1A1A1

a. Place the transmitter RF head right-hand side up.

b. Locate the voltage regulator assembly 38AR1A1A1 (fig. 3–62). Loosen and remove the four green-circled mounting screws. Pull the module up, carefully disengaging the connector.

c. To install the replacement module, carefully engage the connector of the module with the chassis connector by pushing the module straight down.

d. Tighten the four green-circled screws.

3–129. Replacement of Control-Indicator 34A4

Replacement of control-indicator 34A4 is covered in chapter 6, TM 11–5820–540–12.

3–130. Replacement of Frequency Multiplier 34A2A2

a. Place the receiver RF head top side up and locate frequency multiplier 34A2A2 (fig. 3–69).

b. Disconnect plug P1 (34A2A2J1) from 34A2A2J1 of frequency multiplier 34A2A2.

c. Loosen three green-circled mounting screws and carefully lift the module, disengaging it from the chassis connector.

d. To install the 34A2A2 replacement module, position the module over three mounting holes and carefully press home the connector.

e. Tighten the three mounting screws and connect the plug P1 (34A2A2J1) to 34A2A2J1 on the replacement module.

3–131. Replacement of Signal Level Control-Monitor 34A5

a. Place the receiver right-hand side up ar locate signal level control-monitor 34A5 (fi 3–73).

b. Disconnect P1 (34A5J2) and P2 (34A5J from their mating connectors.

c. Loosen three green-circled mounting scre and carefully lift the module, disenaging it fro the chassis connector.

d. To install the 34A5 replacement module, pos tion the module over the mounting holes and car fully press home the connector.

e. Tighten the mounting screws and conne plugs P1 (34A5J2) and P2 (34A5J1) to conne tors J1 and J2 respectively of the replaceme module.

3–132. Replacement of Intermediate Frequency Amplifier 34AR1

a. Place the receiver RF head bottom side u and locate intermediate frequency amplifi 34AR1 (fig. 3–76).

b. Disconnect plug 34A1W1A1P2 fro 34AR1J1.

c. Loosen the three green-circled mountir screws and carefully lift the module, disengagir it from the chassis connector.

d. To install the replacement module, positio the module over the mounting holes and careful press home the connector.

e. Tighten the three mounting screws ar reconnect plug 34A1W1A1P2 to 34AR1J1.

3–133. Replacement of Frequency Mixer Stage 34A7

a. Place the receiver RF head bottom side u and locate frequency mixer stage 34A7 (fi 3–76).

b. Disconnect plug P1 (34A7J2) and P (34A7J1) from J2 and J1 respectively of 33A7.

c. Loosen the three green-circled mountir screws and carefully lift the module, disengagir it from the chassis connector.

d. To install the replacement module, positio the module over the mounting holes and careful press home the connector.

e. Tighten the three mounting screws ar

onnect P1 (34A7J2) and P2 (34A7J1) to J2 and J1 pectively of 34A7.

34. Replacement of Power Supply 34PS1

Deleted.

35. Replacement of Low Pass Filter 34FL1

. Place the receiver RF head rear side up. Locate pass filter 34FL1 (fig. 3-69).

b. Disconnect plugs P1 (34FL1J2) and P2 (34FL1J1) from their respective connectors.

c. Place the receiver RF head bottom side up and remove intermediate frequency amplifier 34AR1 as explained in paragraph 3-133.

d. Remove the two mounting screws for 34FL1 which are located on the chassis under intermediate frequency amplifier 34AR1.

e. To install the 34FL1 replacement module, place the module on the mounting holes and tighten the two screws from the other side of the chassis.

f. Replace intermediate frequency amplifier 34AR1 as explained in paragraph 3-132.

g. Connect plugs P1 (34FL1J2) and P2 (34FL1J1) to their respective connectors.

Section VIII. REMOVAL AND REPLACEMENT OF CENTRIFUGAL FAN 5A2B1 OR PRESSURE DIFFERENTIAL MONITOR 5A2A2

36. General

enever a 5A2B1 or a 5A2A2 is to be replaced, h units must be removed from the transmitter e, the faulty unit set aside, and the new unit efully mated with the operational unit through square rubber tube that is glued to the pressure ferential monitor. Then they are to be held ether carefully and replaced in the transmitter e as a unit to maintain a tight air seal at the scroll outlet) of the 5A2B1.

37. Removal

(fig. 3-80)

. Remove the transmitter fixed and RF heads m transmitter case 5A2.

. Unsolder and remove the wires that are con- cted to E3 and E4 on the pressure differential nitor. Tag or mark one of the wires for iden- cation when they are reconnected.

. Loosen the two screws that secure plug P1 to its ting connector.

. Loosen and remove the four mounting screws t secure the pressure differential monitor to the r wall of the transmitter case. (Two of the screw ds are accessible from the outside of the rear ll.)

. In the radio transmitter 5TR1 compartment, nove the three nuts and lockwashers that secure 5A2B1 to the partition wall. Remove the 5A2B1 d the 5A2A2.

. Slip off the square rubber tube from the scroll of 5A2B1 to detach it from the 5A2A2.

38. Replacement

. Mate the replacement unit (5A2B1 or 5A2A2) with the other by sliding the square rubber tube that is gluded to the 5A2A2 over the scroll of the 5A2B1. This must be done with care, since the tube is sized to make a tight fit around the scroll. Be sure the fit is tight and the tube is slid on the scroll as far as it will go. Check to see that the small connecting tube on the pressure differential monitor is properly connected.

b. Holding the two units together, place the 5A2B1 into its position on the partition wall. Fit the lockwashers and nuts over the three bolts and tighten the nuts. Install and tighten the mounting screws that were removed in 3-137*d* above. Replace the transmitter fixed and RF heads.

CAUTION

Be sure that the screws at the four corners of the heads are tightened firmly. Leakage of air around the heads will defeat the purpose of the air filter and endanger the internal, heat-generating parts of the transmitter.

3-139. Testing After Replacement

a. Connect Dummy Load, Electrical DA 437/GRC-103(V), or equivalent, to the transmitter front-panel PWR OUT connector.

b. Set the transmitter AC POWER switch to ON/RESET. The OVERHEAT lamp should light and go out within 10 seconds.

c. Completely cover the air filter with a suitable flat object, such as a sheet of heavy paper cut to the proper size. The OVERHEAT lamp should light and the buzzer should sound. Remove the obstruction immediately.

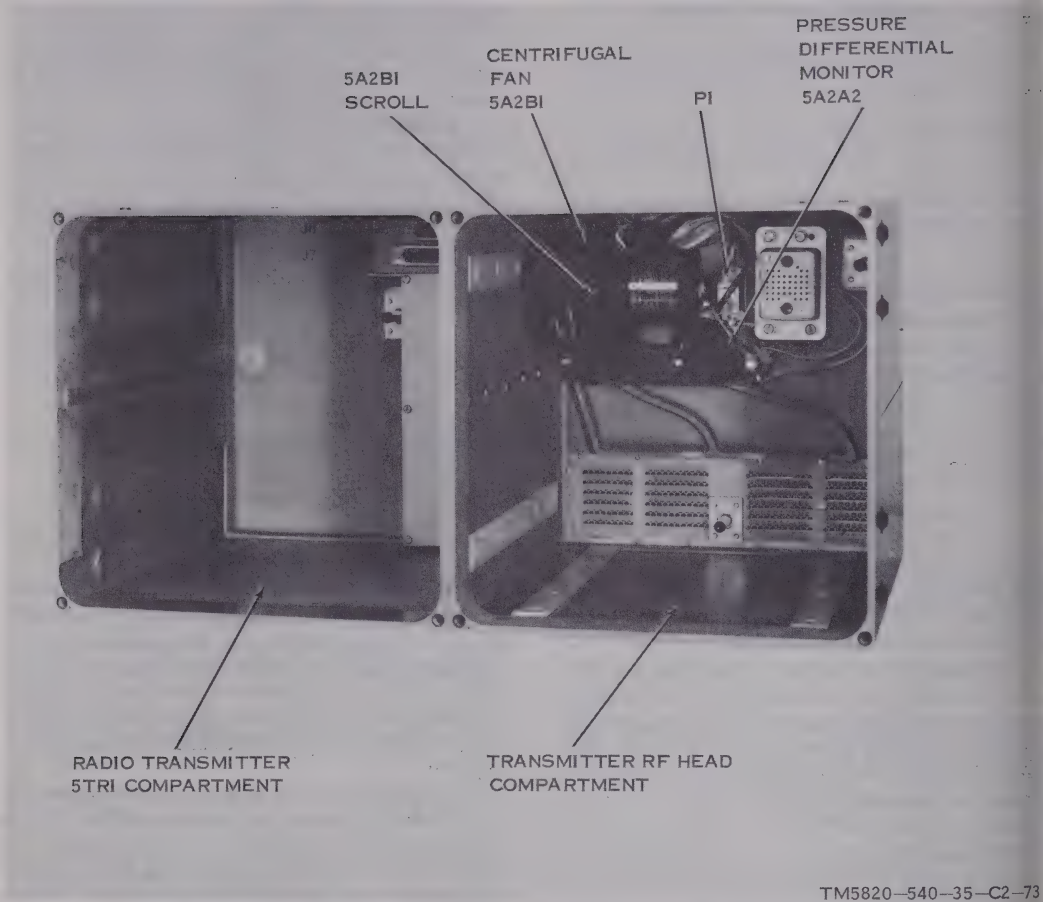


Figure 3-80. Case, Transmitter CY-4637/GRC-103(V), front view.

CHAPTER IV

GENERAL SUPPORT MAINTENANCE

Section 1. INTRODUCTION

1. General

a. This chapter covers general support maintenance of Radio Set AN/GRC-103(V)1 based on the use of Test Facilities Set AN/GRM-95(V)1. It lists the tools and test equipment required to test and repair the radio set. It also covers all tests and alignments performed at system, unit, and/or module levels. Applicable tests and alignment procedures must be performed after each module, unit, or system has been repaired. Repair of some mechanical assemblies is also included in this chapter.

b. Cables, adapters, filters, and similar accessories that are required for tests but are not listed in the appropriate *Test Equipment and Material Required* paragraph will be found in the Test Facilities Set AN/GRM-95(V)1 (para 4-4).

4-2. Test Equipment and Material Required

The following chart lists the test equipment, cables, connectors, and special tools required for general support maintenance of the radio set.

NOTE

Cables and connectors included in the test facility are not listed in this paragraph.

a. Test Equipment.

Nomenclature	Technical Manual	Common Name
Test Facility, Transmitter TS-2866(V)1/GRM-95(V)	TM 11-6625-1696-12	Transmitter test facility
Test Facility, Receiver TS-2867(V)1/GRM-95(V)	TM 11-6625-1696-12	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V)	TM 11-6625-1696-12	Accessory kit
Counter, Electronic Digital Readout AN/USM-207	TM 11-6625-700-10	Counter
Generator, Signal AN/USM-44A	TM 11-6625-508-10	Signal generator
Generator, Signal AN/USM-205	TM 11-6625-665-15	Wide range oscillator
Generator, Signal SG-867/U		Sweep generator
Generator, Thermal Noise SG-419/U	TM 11-6625-413-10	Noise generator
Generator, Signal SG-888/U		Power signal source
Distortion Analyzer TS-1344/U		Distortion analyzer
Indicator, Standing Wave Ratio AN/UPM-108		VSWR amplifier
Insulation Tester, Norma 66701		Insulation tester
Selective Voltmeter AN/USM-306		Level meter
Meter, Modulation ME-57/U	TM 11-6625-400-12	Deviation meter
Multimeter TS-352B/U	TM 11-6625-366-15	Multimeter
Oscilloscope AN/USM-140	TM 11-6625-535-15-	Oscilloscope
Oscilloscope AN/USM-281		Oscilloscope
Shortcircuit Plug (modified UG-573B/U)		
Voltmeter, Digital AN/GSM-64	TM 11-6625-444-15	Digital voltmeter
Voltmeter, Electronic ME-30A/U	TM 11-6625-320-12	VTVM
Wattmeter AN/URM-98	TM 11-6625-433-15	Power meter
Wattmeter AN/URM-120	TM 11-6625-446-15	Wattmeter

b. Connector. Adapter-connector UG-636A/U (type C (male) to BNC (female)).

c. Special Purpose Cables, Depot Fabricated (fig. 5-18).

Cable Assembly, Special purpose, Electrical CMC 217-800009

Cable Assembly, Special Purpose, Electrical CMC 217-800010

Cable Assembly, Special Purpose, Electrical Branched, CMC217-800011

Cable Assembly, Special Purpose, Electrical Branched, CMC 217-800012

Cable Assembly, RF CMC 217-800013

d. Special Tools.

Extractor Tool, Cannon CET C6B
Gage, Thickness 0.003 in.
Wrench, Torque

4–3. Organization of Troubleshooting and Repair Procedure

Listed below is a group of tests arranged to reduce necessary work and to aid in tracing the trouble to the defective stage or component.

a. Operational Tests. The first step in servicing a defective module, assembly, or unit is to connect it to the test facility and check its performance to determine the nature of the fault. When abnormal indications have been obtained, isolate the fault with the appropriate troubleshooting procedures.

CAUTION

If no output is available during tests, do not change the setting of any of the variable components; serious misalignment may be introduced.

b. Visual Inspection. Look for broken or loose wires in cables and connectors; external connector-to-cable joints may be broken during attempts to disconnect the cable. Remove the module covers and inspect the wiring and solder points for loose connections. Tiny cracks in printed circuit boards can cause intermittent operation; a magnifying glass is often helpful in locating these defects.

c. Troubleshooting Charts. Troubleshooting charts, where furnished, provide a systematic method of localizing the fault to a defective stage, circuit, or component.

d. Voltage Measurements. Voltage measurements along the signal path are very useful in signal tracing. Weak signal or the absence of a signal will aid in isolating the trouble to a defective stage or component. General procedures for voltage measurements are given in paragraph 4–5.

e. Waveform Analysis. Where required, waveforms are used to analyze the nature of trouble. These waveforms are compared with waveforms provided and resistance measurements are then used to locate the trouble.

f. Resistance Measurements. Resistance measurements help locate a faulty component. Use the resistance charts provided. Refer to paragraph 4–6 for resistance measurement procedures.

g. Test Points. Where possible, test points should be used for connection to test equipment. Test points are shown on the schematic diagram and on parts location diagrams.

h. Intermittent Trouble. On all of the test there is a possibility of intermittent trouble This type of fault may often be made to a pear by tapping or jarring the module whi under test.

4–4. Use of Test Facilities Set AN/GRM–95(V)

Test Facilities Set AN/GRM–95(V)1 is mad up of three major units:
Test Facility, Transmitter TS–2866(V)1/GRM 95(V) Test Facility, Receiver TS–2867(V)1 GRM–95(V) and Accessory Kit, Test Facilitie Set MK–1173(V)1/GRM–95(V).

a. The test facility permits testing, alignmen and troubleshooting procedures to be carried o on the complete radio set, the individual unit or the individual modules. In conjunction wit additional test equipment, the test facility pr vides the following:

(1) An interface between the radio set an the test equipment.

(2) Internal signal sources, power source and detection, measurement, and internal calibra tion facilities.

(3) A means of substitution checking som radio set modules.

b. The accessory kit contains a power suppl numerous test jigs, and items of specialized te equipment of particular use in testing certai modules.

c. Before using the test facility, refer to TI 11–6625–1696–12 for starting and stopping pr cedures.

4–5. Dc Servicing and Voltage Measurements

a. Dc Servicing. Dc voltage measurements ar an effective method of troubleshooting defectiv radio sets and modules.

(1) The radio set is largely self-sectionali ing; most faults in the transmitter and receive will provide one or more abnormal indication on the respective front panel meter. When d servicing is done in conjunction with the test fa cility, additional information may be obtaine from the test facility indicator lamps and/o meter indications. In general, any fault relate to the +28v, +26v, +12v, –12v, and/or 630v sup plies can be easily traced through meter indica tions. Refer to the applicable troubleshootin charts to localize and isolate the defective modul or components.

(2) Dc servicing of individual modules is ily done by removing the module covers, con- ting the module to the appropriate connector the test facility; and checking the supply volt- es. A short in the supply voltage module will readily indicated by the associated supply indi- or lamp on the test facility lamp being ex- guished. Check the supply voltage at all dis- bution points with a multimeter and use the propriate schematic diagram to isolate the fault.

b. Voltage Measurements. In-circuit voltage easurements are useful in isolating a defective mponent or stage. Transistors can be easily ecked by measuring the base to emitter bias. transistor functioning as an amplifier is always rward biased. The base to emitter voltage of y turned-on silicon transistor is approximately 3v; that of a germanium-type transistor ap- oximately 0.4v. A nonconducting transistor ows the full supply voltage at the collector.

(1) A quick method to check whether a for- ard-biased transistor functions as an amplifier to remove the forward bias by shorting the nitter to base. The collector voltage in this case ould rise to the approximate level of the supply ltage.

(2) Incorrect or absent supply voltage is ually caused by defective Zener diodes. Check r the correct operating voltage across the Zener ode. Refer to the appropriate schematic, trouble- ooting procedure, and/or semiconductor refer- ce books.

(3) PIN diodes, normally used as switch- g diodes, are semiconductor devices with very w resistance when forward-biased and high re- stance when reverse-biased. A large voltage op across the PIN diode when forward-biased dicates a defective diode.

(4) Field effect transistors (FET) can be ecked by varying the voltage at the gate and serving the voltage change appearing at drain d source. Only two field effect transistors e used in the radio set, one in electrical fre- ency synthesizer 1RE1A2 and the other in elec- ical frequency synthesizer 5TR1A2. Changing nthesizer frequency is an effective way of vary- g the voltage at the gate of the FET.

CAUTION

Be careful when using a VTVM or oscilloscope to measure voltages within an operating module. The measuring instrument may upset the characteristics of some circuits, particularly RF circuits, and false indications may be obtained. Refer to the appropriate module troubleshooting procedure for correct use of measuring instruments.

(5) Checking signal voltages within an operating module is, in most cases, an effective way of troubleshooting a module. Signal voltages can be checked using a VTVM or oscilloscope.

(6) Peak-to-peak voltages of pulse and square waves can be measured with an oscilloscope.

(7) When measuring voltages, use the test points provided, rather than break the conformal coating to get to connections. Synthesizer boards can be extended using extender boards; test points are provided in all extender boards for signal and supply voltage measurements.

(8) The 600v supply to the power amplifier tubes can be readily measured at tube plate cooling fins or an appropriate filter-connector; test points have been provided for measuring and adjusting filament voltage and power amplifier tubes bias.

4–6. Resistance Measurements

a. In-Circuit Resistance Measurements.

CAUTION

Do not make resistance measurements on Q1 and Q2 of radio frequency amplifier 2A1AR1 and elapsed time indicator DS1 in power supply 5TR1PS1 and circuit card assembly 6AR1A2A2. If the correct polarity of meter leads (red +) are not observed when checking FL28 or FL29 in power supply 5TR1PS1 and the low voltage tantalum electrolytic capacitors, the components will be damaged. In-circuit checking of components should be carried out as much as possible. Most components can be checked for open or shorted conditions using the allocated multimeter. Use the Rx100 or Rx10K scale when there is a possibility of damaging the components. Loss of signal or supply voltage in a module may be caused by shorts, poor connections at plugs, broken wires, etc. Continuity checks using the allocated multimeter will usually indicate the source of trouble; use the appropriate schematic diagram and interconnecting diagram for guidance. Use the interconnecting box test set supplied with the test facility accessory kit to check the interconnecting cables of the receiver and transmitter case. In-circuit resistance checking will

usually provide adequate indication of a faulty transistor or diode. The following is a suggested method.

(1) *NPN transistors.* With the red (+) lead of the multimeter on the base and the black (–) lead first on the collector and then on the emitter, the multimeter should normally indicate several hundred ohms (R×100 scale). With reverse leads (black (–) on base) the resistance to collector should be very high or infinity, while the resistance to the emitter should be several meghoms (depending on the other components in the circuit).

(2) *PNP transistors.* Reverse connections and indications in (1) above.

(3) *Diodes.* With diodes of type 1N914 or similar, place the black (–) lead of multimeter on the cathode, the red (+) on the anode; the meter should indicate several hundred ohms. Reverse the leads and a very high or infinite resistance should be obtained, depending on the circuit configuration.

b. Out-of-Circuit Resistance Measurements. Under certain conditions, due to circuit configurations, it may not be possible to check a transistor or other component in-circuit; in this case the component must be disconnected. Remove the suspected faulty component using the proper procedure (para 4–14) and check as described in *a* above. Only one end need be disconnected in order to check diodes, varicaps, and some types of Zener diodes. An additional test for an NPN transistor consists of connecting the black (–) lead of the multimeter to the emitter and the red (+) to the collector which should give an infinite resistance indication. Next connect the red (+) lead to base and note the resistance reading; then short the base lead to collector to 'turn on' the transistor and this should produce a slightly lower reading on the meter. Reverse multimeter leads for PNP transistors.

CAUTION

Do not check field effect transistors with the multimeter; static charge from hands to gate when the transistor is out of circuit and when leads are not shorted can damage the component.

4–7. Inspection of Cable Assemblies

a. If trouble is suspected in cable assemblies, look for broken wires, poor grounds, or in the case of shielded wires, inner conductor shorted to grounded shield. Continuity checks, referring to the appropriate schematic diagram, will reve broken wires in cable assemblies. A wiring fa in the interconnecting cable assemblies in t transmitter or receiver case can be located using the test set interconnecting box (part the test facility accessory kit). Connections subminiature RF connectors can be pull-teste and visually inspected for open circuits, poor s der connections, or poor ground connections.

b. If one or more defective wires are found a wiring harness, replace the damaged wire wi another of the same size and length, runnin the wire through the plastic cable covering. Wi ing can be checked using the allocated multimet and using the appropriate schematic diagram. a damaged wire to a connector is found, remo the cover from the wiring side of the conne tor and repair, following approved solderi techniques; replace the short insulation slee over the wire to the connector pin.

c. If a wire in a laced harness requires r placement, the lacing should be cut, and the d fective wire removed and replaced by a new wi the same size and length. It is sometimes poss ble, if the lacing is not too tight, for the faul wire to be slipped out and a new one substitute When replacing the lacing, it should be lac tightly so that it cannot loosen again. Anoth but less acceptable method is to run new wi along the cable, lacing it at intervals. The o conductor should be cut back into the cab as far as possible and the ends insulated.

d. A broken wire can be joined togethe soldered and the joint covered with spaghetti, b this method should only be used as a last reso when no other methods are possible.

4–8. Soldering and Unsoldering Procedures

To insure high reliability of electrical conne tions, certain procedures for hand solderi must be adhered to.

a. Use low wattage or temperature controlle soldering irons and thermal (heat) sinks to pr vent damage to heat-sensitive components, su as semiconductors, glass bead capacitors, and i sulating materials.

b. Use appropriate soldering iron tips ar solder quickly to prevent long periods of exce sive heat during soldering and unsoldering printed circuit boards covered with conform coating.

c. Do not use transformer-type solder gun

d. Check the condition of soldering tips. I not allow oxidation scale to accumulate on t

Maintain a bright, thin, but continuous tin-
tip surface.
. Use a 60/40 type solder for tinning and
eral use. Use a low-melting point 63/37 type
ler on printed circuit boards and when
lering heat-sensitive components.
. Remove excess flux, grease, or oil from the
lering points, using ethyl or isopropyl alcohol.
. Remove the conformal coating from the joint
be soldered with a board knife or soldering
n.
. Use a heated copper braid to absorb the
ted solder when unsoldering. Avoid using a
ler sucker to remove the solder from printed
uit boards; this method may damage the joint
/or the printed circuit board.
Avoid excessive temperatures to prevent un-
able joints and damage to parts. Use heat
ks, such as long-nose pliers, to protect the com-
ents.
Allow the solder to cool at room tempera-
. Do not use liquids to cool a soldered con-
ion.

NOTE

ver use any abrasive cleaning agents on solder
eas.

Remove all visible flux and impurities from
ol solder joint using a medium stiff material
ynthetic bristle brush and approved solvent.
soldered connection should be clean and have
nooth, undisturbed appearance.
Use a wire brush to remove oxide, paint, and
other foreign matter from terminals before
ching wires and leads for soldering. Use a
ial type white eraser to remove gold plating
n solder areas.

. Replacement of Filter Connectors

There are two basic types of filter connec-
used in the radio set: the soldered-in type
the screw-in type. The screw-in type filter
nectors are used mainly at output con-
ors of RF heads and power supplies. The
ered-in type are used mainly within modules.

NOTE

re must be taken when filter connectors are in-
lled so that the porcelain is not cracked or dam-
ed, or that excess solder does not run over the
dy of a component, causing a short circuit to chas-

To replace the screw-in type filter connec-
remove connecting wires, lockwasher, and nut.
en the new component is installed, check first for continuity and shorts to ground or chassis, then replace the connecting wires.

c. To replace the soldered-in type filter connector, remove the connecting wires and unsolder the defective component; insure that the mounting and mounting hole are clear of solder. Install the new unit by heating the mounting frame until solder flows freely to both sides of the mounting frame. Cut the end leads to the required length, check for continuity and absence of shorts to chassis or ground, then replace the connecting wires, using no more heat than necessary. Excessive heating may change the characteristics of a component. Normally, a heat sink is not required, since filter connectors are usually mounted on a chassis or a metal frame.

d. Thoroughly inspect the filter connectors after connections are completed.

4–10. Replacement of Connectors

Radio Set AN/GRC–103 uses several types of multipin and RF connectors which will need replacing if they become defective.

a. Multipin Connectors. Remove and label all wires connected to the connector. Clean all wires of solder and insure that the wires are properly stripped. Fill the pin cups on the replacement connector with a small amount of solder before inserting the wire ends into the pin cups. Allow the solder to cool, pull the wire to insure that it is solidly attached, then slide the insulating sleeve over the soldered connection so that it fits snugly against the connectors.

b. Microminiature-Type Connectors. The following is a general procedure applying to most microminiature connectors:

(1) Slide the connector clamp nut over the covering of the RF cable.

(2) Remove 1/8 inch of the outer covering of the cable (fig. 4–1).

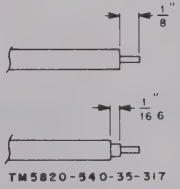


Figure 4-1. Details of RF cable stripping.

(3) Remove 1/16 inch of the braid and inner insulation.

(4) Insert the inner conductor into the connector pin and solder through the small opening.

(5) Trim off excess braid.

(6) Slide the clamp nut over the connector and tighten the clamp nut.

c. Type UG-573A Connectors (fig. 4-2). The following is a basic procedure:

(1) Slide the connector nut and gasket over the cable and remove 5/16 inch of the outer covering of the cable.

(2) Comb the braid and fold it out.

(v) Pull the braid wires forward and taper to the center conductor.

(4) Place the clamp over the braid and push back against the cable jacket.

(5) Fold back the braid wires, trim to the proper length, and fold over the clamp.

(6) Cut back the dielectric to the correct length so that the contact pin fits snugly against the center conductor.

(7) Solder the contact pin to the center conductor through the opening in the contact pin.

(8) Insert the cable end with the soldered contact into the connector body.

(9) Insure that the sharp edge of the clamp is properly seated in the gasket. Tighten the nut.

NOTE

In a plug, the end of the contact pin should be flush with the insulator. In a jack, there should be a clearance of 0.10 inch between the end of the contact and the top of the insulator.

4-11. Conformal Coating

a. All printed circuit boards in the radio set are protected against environmental conditions by conformal coating. The conformal coating used on printed circuit boards is Conathane CE-1 which has a good repairability factor, and not normally require any tool except a solde iron to make repairs, although a board k is useful when removing the conformal coat

b. All printed circuit boards should be thorou cleaned using Freon or alcohol, dried, then formal coated and cured before being restore service. If Conathane CE-1155 is not avail use the nearest equivalent material that is ceptable.

4-12. Sealing Controls

a. In keeping with the general procedure using red paint on all areas that normally sh not be moved or adjusted, nearly all adjust resistors, capacitors, and all alignment cont are sealed after adjustment.

b. These sealed controls should not be adj ed except when required to follow alignment adjustment procedures. Consult the appropr module test and repair procedures before adj ing any of the sealed controls. The majority such controls are usually sealed with red pa

c. All duplexer cavity cups and adjustm screws on cups are sealed after alignment Glyptol. The filament and bias controls power amplifier tubes located on the transmi RF head use locknuts to keep them fixed their adjustment points.

4-13. Setscrew Removal and Replacement

a. The majority of setscrews in the radio are secured with Loctite to insure there is no

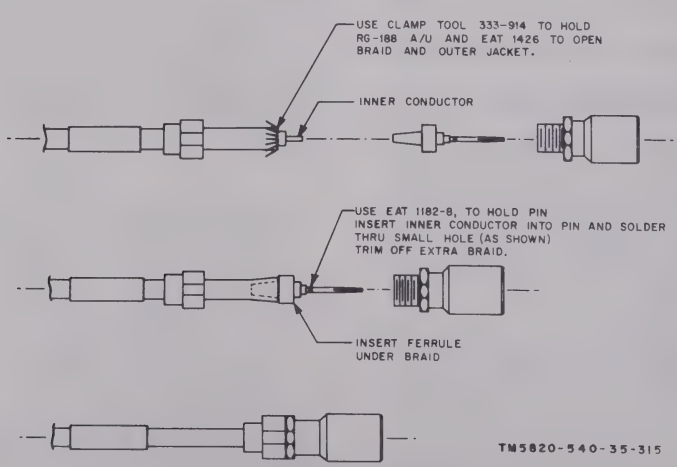


Figure 4-2. Details of cable connector assembly.

ility of movement after the mechanical align-
nt and adjustment is carried out. Several
es of Loctite are used depending on the retain-
requirements of the component:

(1) Type AA for maximum locking of fine
eads.

(2) Type AVV for high strength locking of
rse threads.

(3) Type C for locking any fine threads
t must be easily removable.

b. To remove a setscrew, it may be necessary
cautiously heat the joint locally using a high
tage iron or gas torch. Tapping the setscrews
efully, using a hammer and pin-punch, will
sist in jarring the screw loose and removing
rdened sealant from disassembled parts. After
disassembly of Loctite-treated parts, an ac-
mulation of powder may remain; this should
removed by wiping or air hosing. Loctite can
n be reapplied and the setscrew replaced.

c. To reassemble, apply the correct type of
ler required (a holding power of 20% to 90%
appropriate where maximum holding is neces-
ry and 5% to 20% for setscrews that might
ssibly require occasional adjustment).

d. Before any setscrew is removed, refer to the
propriate test procedures; the removal of a
mponent secured by a setscrew may result in
alignment or adjustment being necessary.

NOTE

The setscrews securing the microswitches of control indicators 2A2 and 6A3 are secured by Glyptol rather than Loctite.

4-14. Replacement of Components

a. Component Mounted on Printed Circuit Boards. Remove the defective component by unsoldering its leads from the printed circuit board following approved unsoldering procedure (para 4-8).

(1) Check and clean all replacement compo-
nt leads prior to soldering, regardless of visual
pearance.

(2) Use smooth finished tools for bending
d avoid any sharp-edged tool which may pinch
break the lead. Leave a distance of at least
ice the diameter of the lead from the end
al of the component to the start of the bend.
is rule also applies to all components with
elded leads, such as tantalum capacitors.

(3) Components that weigh 1/4 oz or
ore are secured by a suitable mounting
acket, and potted or embedded in silicon rubber
its equivalent. When replacing such a compo-
nent, be sure that the original mounting bracket is retained.

(4) Components mounted in a vertical position should not exceed 1/2 inch in height, otherwise they may cause a short circuit to the module cover. When diodes must be mounted vertically, with the cathode end close to a source of heat, use a setback loop in the cathode lead.

(5) Position the replacement component in the same place as the removed component. Do not mount components on top of other components. Position the replacement components so that any identification mark, such as the part number, symbol, value, etc., is readily visible.

(6) Observe the polarity of replacement diodes, transistors, and electrolytic and tantalum capacitors.

(7) Position all delicate lead-mounted components at least 1/64 inch away from boards or adjacent components. Components which are expected to dissipate more than 1 watt of heat should clear the board and all adjacent components by 1/32 to 1/16 inch. When the component is attached to a printed circuit board by a clinched lead, the clinched lead must be on and in the direction of the circuit pattern.

(8) Components mounted over exposed circuitry must be insulated unless the components are glass encased.

(9) Jumper wires longer than 1 1/2 inch used in joining two terminals should be secured to the board with a small amount of potting compound at suitable points along the wires.

b. Components Mounted Other Than on Printed Circuit Boards. Where components are mounted on standoff terminals, allow sufficient slack in the leads to components to allow for vibration and temperature changes.

(1) When wires are attached to terminals, sufficient insulation should be stripped off the wire to avoid contact between the insulation and the solder connection. Use proper stripping tools to avoid nicking, damaging, or breaking wires.

(2) The ends of wires soldered to terminals should be wrapped around the terminals 1/2 to 3/4 turn (wires larger than 26 AWG) or 3/4 to 1 1/2 turns (wires smaller than 26 AWG). All portions of stranded wire and component leads which will be soldered should be properly tinned before attachment.

(3) Use the correct type of insulated heat-shrinkable sleeving when replacing a circuit breaker. Use a thermogun for shrinking the sleeving.

c. Component Replacement Procedure

(1) *Air-core coils.* Install the replacement air-core coil, using approved soldering techniques, without changing the contour of the coil, and maintaining the same board-to-coil distance. A complete realignment of the module will be required.

(2) *Ferrite tuned coils.* To replace ferrite tuned coils proceed as instructed in (1) above observing polarity, start, and finish of the coil. Realignment is required after replacement.

(3) *Relays.* Relays are either soldered to the board or chassis-mounted and secured by two screws. Mark the relay pin numbers on individual connecting wires with masking tape before removing the faulty relay. Replace the relay using approved soldering techniques.

(4) *PIN diodes.* The PIN diodes are either soldered to the board or mechanically mounted in special holders. Press the replacement PIN diode into position observing the polarity.

(5) *Small components.* Small fixed capacitors, chokes, fixed resistors, varicaps, and diodes are all replaced following the general procedures described in *a* and *b* above. Observe polarity on all types of diodes, varicaps, and electrolytic capacitors.

CAUTION

Do not touch the leads of field effect transistors with the hands. Damage to the transistor may result.

(6) *Semiconductor devices and microcircu* Replace transistors, binaries, and NOR gates f lowing the general procedures in *a* abo Observe the polarity when replacing the comp nent, and use spreaders where applicable. Wh replacing power transistors on heat sink boar be sure that the insulator is correctly positior and apply heat sink compound. On board-mou ed transistors, replace the case shield or heat si where applicable.

(7) *Board-mounted potentiometers.* Repla the component following general procedures *a* or *b* above; refer to the applicable paragra for alignment procedures.

(8) *Transformers.* Transformers are read replaced. Identify all connecting wires before moving the defective component to facilitate stallation of the replacement transformer.

NOTE

Any repairs on printed circuit boards will require the application of conformal coating (para 4–11).

Section II. MODULE TEST AND REPAIR PROCEDURES

4–15. Transmitter, Radio T–983(P)/GRC– 103(V)

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)/GRM-95(V).	Accessory kit
Selective Voltmeter AN/USM-306	Level meter
Distortion Analyzer TS-1344/U	Distortion analyzer
Voltmeter, Electronic ME-30A/U	VTVM
Generator, Signal AN/USM-44A	Signal generator
Generator, Signal AN/USM-205	Wide range oscillator
Counter, Electronic, Digital Readout AN/USM-207.	Counter
Voltmeter, Digital AN/GSM-64	Digital voltmeter
Wattmeter AN/URM-98	Power meter
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) *Operational check.*

(*a*) Connect the test equipment as shown n figure 4–3A.

NOTE

Position the air outlet so that the flow is directed over the power supp heat sink.

(*b*) Set test facility switches as follow

Switch	Position
S1	ON
S20	S21
S18	58.25
S21	Away from OFF positi
PWR ALM SET LEVEL...	Fully CCW

(*c*) Switch on the unit under test a check for the following:

1. AC POWER lamp should light.
2. LOW POWER lamp should light.
3. SYNC lamp may light and should out within 10 seconds.
4. Buzzer should sound.

(*d*) Press S24 on the test facility. T OVERHEAT alarm lamp on the unit under t should light.

(*e*) On the unit under test, set the dimm switch to the BUZZER OFF position. The buzz should be silent and all alarm lights should di

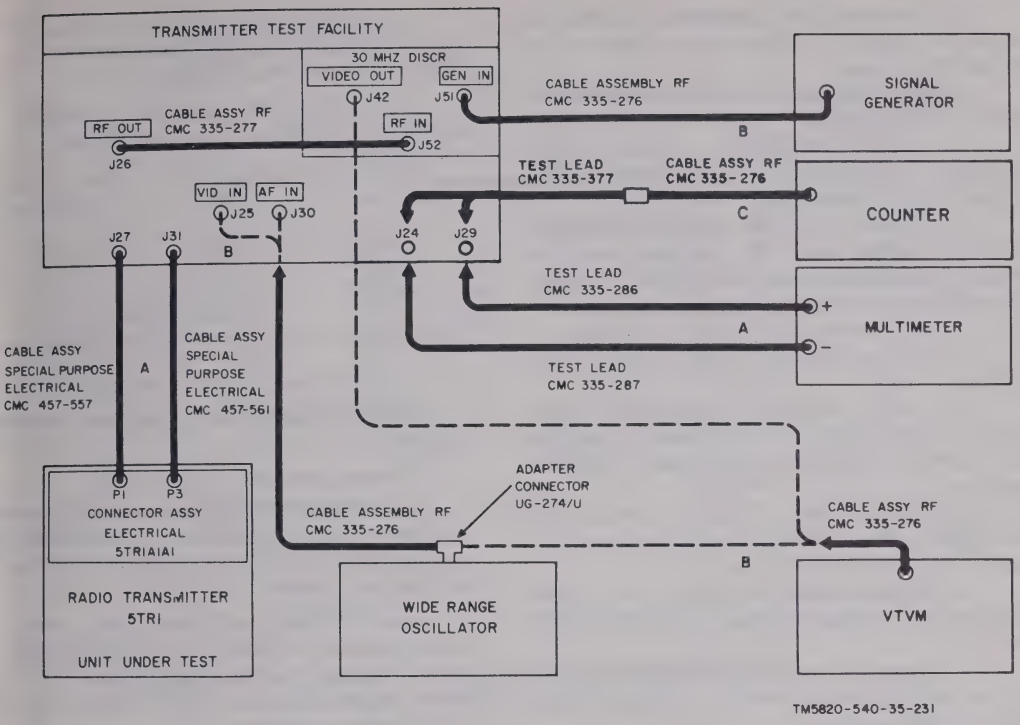


Figure 4-3. Transmitter fixed head, operational check, test setup.

(*f*) Return the dimmer switch to ALARM ORMAL. The buzzer should sound and alarm mps brighten.

(*g*) Press the BUZZER OFF button on e unit under test to silence the buzzer.

(*h*) Set test facility switch S22 to TEST. ne multimeter should indicate 14 v ac. Release 22.

(*i*) Connect the counter to connectors 24 and J29 as shown in figure 4–3C.

(*j*) Set test facility switch S22 to TEST. ne counter should indicate 400 Hz ±20 Hz. elease S22.

(*k*) Set switch S21 to OFF. Press and ld S23. Set S21 to +600V. Test facility ter M1 should indicate in the green band.

(*l*) Connect the test equipment as shown figure 4–3B.

(*m*) Set the wide range oscillator to 10 Hz at a level of 705 rms as indicated on the TVM.

(*n*) Check the metering on the unit under st. Indications should be as shown in chart elow.

Meter position	Indication
12V DC	Within green band
28V DC	Within green band
OSC	Between 20 and 90 percent of full scale
DOUBLER	Between 20 and 90 percent of full scale
MULT	Zero
DRIVER	Zero
PWR OUT	Zero
REFL PWR	Zero
12 CH PCM	Within green band using INPUT control on unit under test.
24 CH PCM	As above.
FDM	As above.

NOTE

If abnormal indications are obtained in any of the above tests, carry out the troubleshooting procedures (*c* below).

(2) *Deviation check.*

(*a*) Connect the test equipment as shown in figure 4–3B.

(*b*) Set the signal generator frequency to 146.50 MHz and the wide range oscillator to 10 kHz at 705 mv rms.

(*c*) Set test facility switch S20 to the 30 MHz DISCR position.

(*d*) Adjust the signal generator output level for an indication of 50 percent of full scale on test facility meter M1.

(*e*) Adjust the signal generator frequency until test facility meter M2 indicates zero (at center). Recheck the signal level on M1. If necessary readjust the output level of the signal generator for a 50 percent of full scale indication.

(*f*) Set test facility switch S21 to 0 DB position.

(*g*) On the unit under test, set the meter selector switch to 24 CH PCM and adjust the INPUT control so that meter indicates within the green band.

(*h*) Connect the VTVM to J42 on the test facility. The VTVM should indicate between 130 and 193 mv rms.

(*i*) Repeat above for 12 CH PCM. The VTVM should indicate between 78 and 116 mv rms.

(*j*) Tune the wide range oscillator to 1.0 kHz and set the meter switch on the unit under test to FDM position.

(*k*) On the unit under test, adjust the INPUT control so that the meter indicates within the green band. The VTVM should indicate between 33 and 58 mv rms.

(*l*) Connect the wide range oscillator to J30 AF IN connector to the transmitter test facility and the VTVM to the UG-274/U connector at the output of the wide range oscillator.

(*m*) Set the wide range oscillator to 1.0 kHz and adjust its output level to –10 dbm as indicated on the VTVM.

(*n*) Connect the VTVM to connector J42; the VTVM should indicate between 13 and 29 mv rms.

NOTE

If due to residual fm on the unit under test, the deviation cannot be measured accurately, increase the level of the test signal to +2.0 dbm. This should give an indication of between 75 and 115 mv rms at J42.

(*o*) If the results in (*h*), (*i*), (*k*), and (*n*) above are not as specified, check electrical frequency synthesizer 5TR1A2 (para 4-19).

(3) *Deviation attenuator check.*

(*a*) Using the test setup shown in figure 4-3B, connect the wide range oscillator to VID IN connector J25 on the test facility.

(*b*) Set the wide range oscillator to 10 kHz at a level of 705 mv rms.

(*c*) On the unit under test set the INPUT control to obtain a 200-mv rms indication on the VTVM connected to connector J42.

(*d*) Check the remaining positions of switch S21 as shown in the chart below.

Test facility switch positions S18	S21	VTVM indication (Millivolts rms
58.25	6DB	100±3
58.25	12 DB	50±2
61.66[a]	3.5 DB	133±4
61.66	9.5 DB	67±2

(4) *Power output and frequency check.*

(*a*) Connect the test equipment as shown in figure 4-4.

[a] Set the signal generator to 153.333 MHz.

(*b*) Set switch S21 to the +28V position. The power meter connected at J26 should indicate not less than 2.5 watts for all positions of test facility switch S18.

(*c*) On the unit under test, check the meter indication at the OSC and DOUBLER positions for all positions of switch S18. The meter should indicate between 20 and 90 percent of full scale deflection.

(*d*) Replace the power meter at connector J26 with the counter.

(*e*) Check the frequency at all positions of switch S18. The indications should be as shown in the chart below.

S18 position	Frequency (MHz)
47.50	95.000000 ±.001%
48.33	96.666666 ±.001%
50.65	101.31300 ±.001%
52.31	104.62500 ±.001%
54.98	109.95832 ±.001%
58.25	116.50000 ±.001%
61.66	123.33333 ±.001%
63.46	126.93750 ±.001%
66.00	132.00000 ± .001%
67.50	135.00000 ±.001%
72.50	145.00000 ±.001%

(5) *Low power alarm check.*

(*a*) Connect the test equipment as shown in figure 4-5.

(*b*) Rotate the PWR ALM SET LEVEL control on the test facility until the LOW POWER alarm lamp on the unit under test goes out. The digital voltmeter should indicate 1 mv ±20 mv.

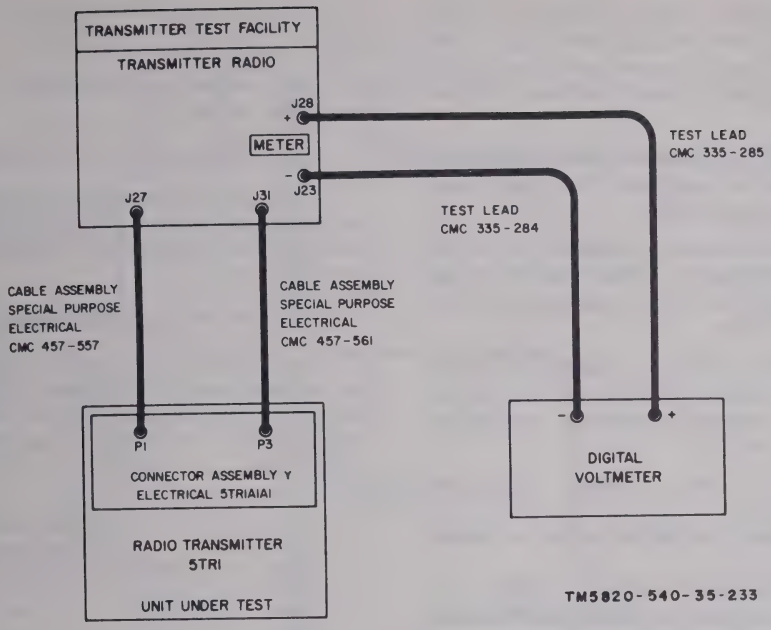


Figure 4-5. Transmitter fixed head, low power alarm check, test setup

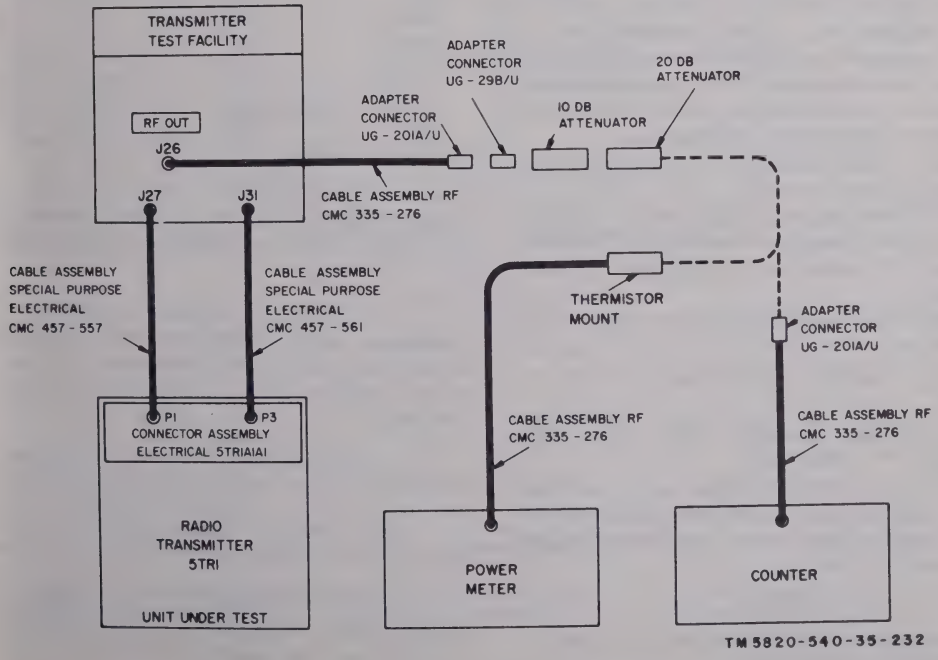


Figure 4-4. Transmitter fixed head, power output and frequency check, test setup.

(*c*) Rotate the PWR ALM SET LEVEL control on the test facility until the LOW POWER alarm lamp on the unit under test lights. The digital voltmeter should indicate 120 mv ±20 mv.

(*d*) If the results obtained in (*b*) and (*c*) above are not as specified, check alarm control 5TR1A3 (para 4–20).

(*e*) If the indications obtained at (4)(*b*) and (4)(*c*) (DOUBLER reading) above are not as specified, check amplifier-frequency multiplier 5TR1A4 (para 4–21).

(*f*) If the indications obtained in (4)(*c*) (OSC reading) and (4)(*e*) above are not as specified, check electrical frequency synthesizer 5TR1A2 (para 4–19).

(6) *Video frequency response testing and troubleshooting.*

(*a*) Connect the test equipment as shown in figure 4–6A.

(*b*) Set the coaxial switch to position 2.

(*c*) Set test facility switches S20 to 30 MHz DISCR and S18 to 58.25 MHz.

(*d*) Tune the signal generator to 146.5 MHz and adjust the output level for a 50 percent of full scale indication on test facility meter M1.

(*e*) Adjust the signal generator frequency until test facility meter M2 indicates zero (at center). Recheck the signal level on M1; if necessary readjust the output level of the signal generator for a 50 percent of full scale indication.

(*f*) On the unit under test, set the metering switch to the 12 CH PCM position.

(*g*) On the unit under test, set the INPUT control to midrange.

(*h*) Tune the wide range oscillator to 10 kHz and adjust the output level for a 25 percent of full scale indication on the meter of the unit under test.

(*i*) Check the signal-to-noise ratio as described below.

1. Tune the wide range oscillator to 960 kHz.

2. Adjust the level meter to 960 kHz and record the indication.

3. Disconnect the wide range oscillator and increase the gain of the level meter by 20 db. The indication should not exceed that obtained in *2* above.

NOTE

During the following tests do not disturb the INPUT control on the unit under test.

(*j*) Tune the wide range oscillator to kHz.

(*k*) Adjust the level meter to 10 kHz a record the indication.

(*l*) Set the coaxial switch to position 1.

(*m*) Adjust the variable attenuators to tain the same indication as that obtained in above. Record the attenuator settings. This is reference level.

(*n*) Set the coaxial switch to position 2.

(*o*) Repeat (*j*) through (*n*) above for frequencies above 10 kHz listed in the chart low. Record the attenuation with respect to reference level; it should be as listed in chart below.

Frequency (kHz)	Relative attenuation (db), reference attenuation at 10 kHz		
	Nominal	Minimum	Max
0.125	0.5	0	1.0
0.200	0.3	−0.2	0.8
0.250	0.1	−0.4	0.6
1.0	0	−0.5	0.5
10	0	0	0
30	0	0	0.
60	0	0	0.
120	0.15	0.1	0.
240	0.6	0.5	1.
360	1.3	1.1	2.
480	2.3	1.95	3.
600	3.6	3.0	5.
720	5.2	4.4	7.
840	7	6.0	9.
960	9.6	7.8	12.

(*p*) Increase the output of the wide range oscillator by 12 db and replace the level meter with the distortion analyzer (fig 4–6B).

(*q*) Repeat (*j*) through (*n*) above for the frequencies below 10 kHz as listed in the chart above and record the attenuation with respect to the reference level; it should be as listed in the chart.

(*r*) Set test facility switch S18 to position 72.5 MHz.

(*s*) Tune the signal generator to 75 MHz ±10 kHz and repeat (*d*) through (*q*) above.

(*t*) If the requirements of (*i*), (*o*), (*q*), and (*s*) above are not met, check amplifier-monitor 5TR1A5 (para 4–22).

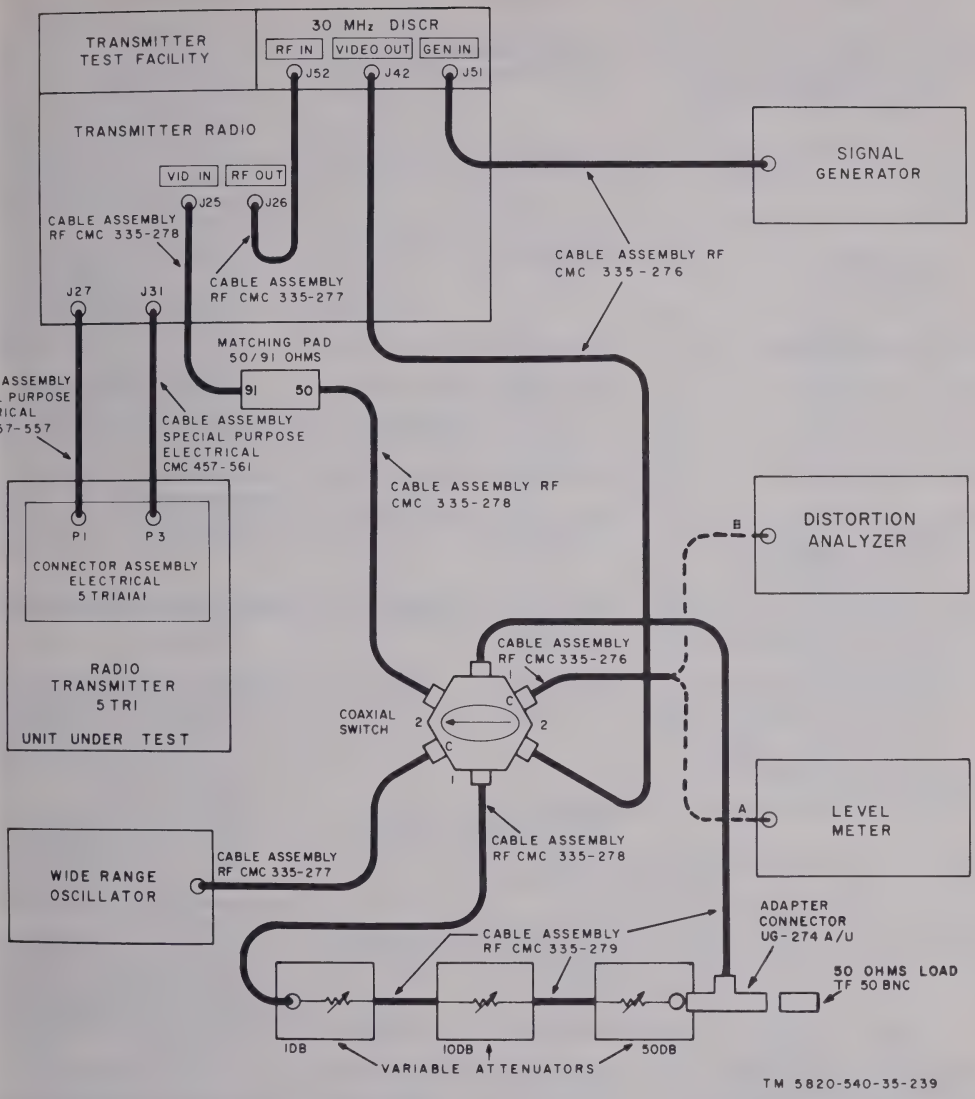


Figure 4-6. Transmitter fixed head, video frequency response check, test setup.

c. Troubleshooting.

NOTE

This chart supplements the troubleshooting charts contained in TM 11-5820-540-12.

Symptom	Probable cause	Checks and corrective measures
With a signal in at VIDEO connector, no meter indication is obtained when the metering switch is set to 12 CH PCM, 24 CH PCM or FDM.	Defective R1 or R2 resistors on monitor panel 5TR1A1.	Check R1 and R2 (fig. 6-14) and replace if necessary.
	Defective wiring	Set the INPUT control fully counterclockwise and check for continuity between P1 pin 10 of 5TR1A1

Symptom	Probable cause	Checks and corrective measures
		and J2 pin 17 of 5TR1A1.
No meter indication with the switch in any position: other indications (lamps, buzzer) are normal.	Defective meter on the monitor panel 5TR1A1.	Set the metering switch to +12V position and measure the voltage across meter terminals; it should read 0.25v dc. If higher voltage is present replace the meter.
	Defective wiring	Measure the resistance between the common terminals of meter switch S1-A and S1-B; it should be 500 ohms.
	Defective meter switch on the monitor panel 5TR1A1.	Set the metering switch to 12 CH PCM position. Measure the resistance from contact 7 of S1-A to contact 7 of S1-B; it should be 5000 ohms.
MULT metering too high	CR1 diode of 5TR1A1 open circuit	Make a resistance check. Replace CR1 if necessary.
MULT metering low or zero	CR1 diode of 5TR1A1 low resistance or short circuit.	Make back-to-front resistance ratio check. Replace CR1 if necessary.
OSC metering too high	R3 resistance of 5TR1A1 open circuit.	Check R3 resistance. Replace if necessary.
OSC metering low or zero	R3 resistor of 5TR1A1 short circuit	Check R3 resistance. Replace if necessary.
When AC POWER switch is set to ON/RESET, the centrifugal fan does not start, lamps do not light, there is no metering.	Defective switch circuit breaker 5TR1A1CB1.	Check switch operation and replace if necessary.
VTVM indication abnormal with meter switch in 24 CH PCM position or FDM position (deviation check, *b*(2) above).	Defective metering circuit in amplifier-monitor 5TR1A5 (fig. 3-1).	Test 5TR1A5 as described in paragraph 4-22.
VTVM indication abnormal with meter switch in all positions (24 CH PCM, 12 CH PCM and FDM) or for af modulation check (para (2) (*l*)) (deviation check, *b*(2) above).	Defective amplifier-monitor 5TR1A5 (fig. 3-1)	Substitute the amplifier-monitor 5TR1A5 with a known good one (para 3-44). If VTVM indications are normal, troubleshoot defective module as described in paragraph 4-22.
	Defective electrical frequency synthesizer 5TR1A2 (fig. 3-3).	Substitute electrical frequency synthesizer 5TR1A2 with a known good one (para 3-45). If VTVM indications are normal, troubleshoot defective module as described in paragraph 4-19.
	Defective power supply 5TR1PS1 (fig. 3-1).	Substitute power supply 5TR1PS1 with a known good one (para 3-47). If VTVM indications are normal, troubleshoot defective module for excessive ripple as described in paragraph 4-23.
VTVM indication abnormal for af modulation check only.	Defective amplifier-monitor 5TR1A5 (fig. 3-1).	Test module as described in paragraph 4-
Abnormal reading at any position of S21 (deviation attenuator check, *b*(3) above).	Defective amplifier-monitor	Test module as described in paragraph 4-
Output power abnormal (power output and frequency check *b*(4) above).	Defective amplifier-frequency multiplier 5TR1A4 (fig. 3-3)	Substitute amplifier-frequency multiplier 5TR1A4 with a known good one (para 3-46). If VTVM indications are normal, troubleshoot defective module as described in paragraph 4-21.
	Defective electrical frequency synthesizer 5TR1A2 (fig. 3-3).	Substitute the electrical frequency synthesizer 5TR1A2 with a known good one (para 3-45). If VTVM indications are normal, troubleshoot defective module as described in paragraph 4-19.

Symptom	Probable cause	Checks and corrective measures
put frequency abnormal	Defective electrical frequency synthesizer 5TR1A2 (fig. 3-3).	Test module as described in paragraph 4-19.
v power alarm operates outside oltage limits (*b*(5) above).	Defective alarm control 5TR1A1A2 (fig. 3-3)	Test module as described in paragraph 4-18. Check associated wiring.
quency response outside limits *b*)(6) above).	Defective amplifier-monitor 5TR1A5 (fig. 3-1)	Test module as described in paragraph 4-22.

NOTE:

temaining faults could be due to either wiring, connectors, or switch 5TR1A1S1. Use multimeter to check these items.

NOTE

M 588; Remaining faults could be due to either wir-g, connectors, or switch 5TR1A1S1. Use multimeter-check these items.

6. Monitor Panel 5TR1A1

nitor panel 5TR1A1 is made up of electrical nector assembly 5TR1A1A1, alarm control R1A1A2, and the front panel switches, con-s, alarms, and indicators. Refer to paragraph 5 for a complete operational check of monitor el 5TR1A1.

7. Electrical Connector Assembly 5TR1A1A1

NOTE

lectrical connector assembly 5TR1A1A1 includes the iring harness and associated connectors of monitor anel 5TR1A1. Check 5TR1A1A1 when troubleshoot-g procedures in paragraph 4–15 indicate wiring ouble.

. *Test Equipment Required.*

Equipment	Common name
Multimeter TS-352B/U	Multimeter

. *Test Procedure.* Refer to the transmitter erconnection diagram (fig. 6–4) and check tinuity between associated connector pins. Re- to paragraph 4–10 for repair or replacement connectors.

18. Alarm Control 5TR1A1A2 or 1RE1A1A2

. *Test Equipment and Material Required.*

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/GRM-95(V).	Transmitter test facility
Multimeter TS-352B/U	Multimeter

. *Test Procedure.*

(1) Use the multimeter to check resistance ween the terminal pins listed in the chart be-. Refer to figure 4–7 to locate the terminals.

Multimeter connections (+)	Multimeter connections (−)	Resistance (ohms ±10% unless otherwise indicated)
E1	E11	Greater than 200k
E2	E4	320 ±5%
E2	E5	Greater than 200k
E2	E12	640 ±5%
E4	E5	Greater than 100k
E3	E6	100 ±5%
E3	E13	320 ±5%
E5	E4	Less than 2k
E5	E16	Less than 3k
E7	E9	Infinity
E7	E10	0
E8	E11	Greater than 200k
E11	E1	Less than 3k
E11	E14	100
E11	E15	Less than 3k
E12	E4	320
E12	E5	Greater than 200k
E15	E11	Greater than 200k
E16	E5	Greater than 200k
E17	E18	0

(2) Connect the test equipment as shown in figure 4–8.

(3) Set test facility switches S1, S6, and S17 to their ON positions.

(4) Check the operation of relay K1 in the unit under test; connect the power supply and measure the resistance between the test points as shown in the chart below.

Power supply connections (+)	Power supply connections (−)	Connect multimeter between	Resistance (ohms)
E11	E1	E7 and E10	Infinity
		E7 and E9	0
		E17 and E18	Infinity
		E17 and E19	0
E11	E8	E7 and E10	Infinity
E11	E15	E7 and E10	Infinity (1RE1A1A2 only).

c. Troubleshooting (fig. 6–14).

Symptom	Checks and corrective measures
Abnormal indication of any resistance measurement (*b*(1) above.)	Refer to figure 6-14; check components in defective circuit; replace components as required.

Symptom	Checks and corrective measures
Abnormal indication with power supply (−) connected to E1, (*b*(4) above); other tests normal.	Check and replace diode CR1.
Abnormal indication with power supply (−) connected to E1 or E8 (*b*(4) above).	Check R7 and K1 relay; replace as required.
Abnormal indication with power supply (−) connected to E8 (*b*(4) above); other tests normal.	Check and replace diode CR3.
Abnormal indication with power supply (−) connected to E15 (*b*(4) above); other tests normal.	Check and replace diode CR5.

4–19. Electrical Frequency Synthesizer 5TR1A2 or 1RE1A2

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set	Accessory kit
MK-1173(V)1/GRM-95(V).	
Voltmeter, Digital AN/GSM-64	Digital voltmeter
Counter, Electronic Digital Readout AN/USM-207.	Counter
Generator, Signal AN/USM-44A	Signal generator
Wattmeter AN/URM-98	Power meter
Meter, Modulation ME-57/U	Deviation meter
Selective Voltmeter AN/USM-306	Level meter
Voltmeter, Electronic ME-30A/U	VTVM
Generator, Signal AN/USM-205	Wide range oscillator

b. Test Procedure.

CAUTION

Removal and insertion of circuit boards while power is applied to the synthesizer may induce transient voltages which are harmful to certain components. Before removing or inserting a board, set test facility switch S17 to OFF.

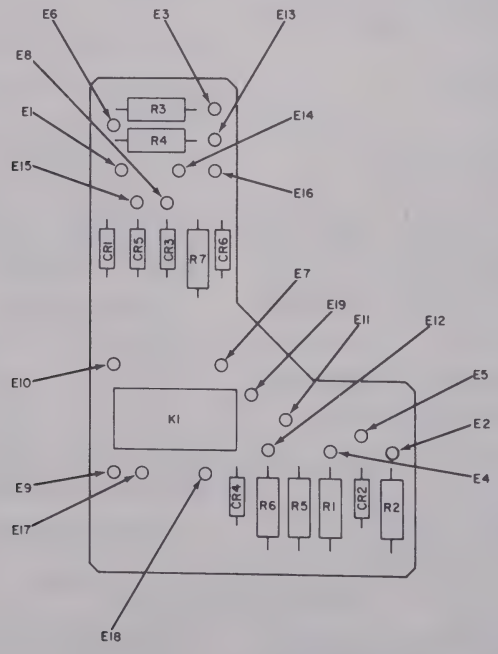


Figure 4-7. Alarm control, 5TR1A1A2 or 1RE1A1A2 parts location.

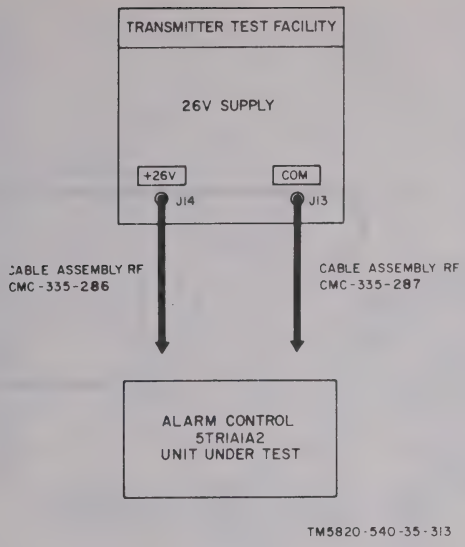


Figure 4-8. Alarm control, 5TR1A1A2 or 1RE1A1A2 test setup.

(1) *Preliminary setup.*

(*a*) Set the test facility controls as follows:

Switch	Position	Normal indication
S1	ON	
S18	72.50	
S20	S17	M1 on test facility indicates within the green band.

(*b*) Remove the synthesizer cover plate.

(2) *Field effect transistor operating volt- adjustment.*

(*a*) Extend signal data converter-storer rd 1RE1A2A8 or 5TR1A2A8 from the syn- sizer, using extender board CMC 457–697 g. 4–9).

(*b*) Connect the digital voltmeter between 4 of Q6 (+) and TP3 (–) of the extender rd.

(*c*) Set switch S17 on the test facility ON. The digital voltmeter should indicate 5v ±0.2v dc.

(*d*) If necessary, adjust R15 (fig. 4– on 1RE1A2A8 or 5TR1A2A8 until the digital tmeter indicates 11.5v ±0.2v dc.

(*e*) Set switch S17 on the test facility to F and reinstall the extended board.

(3) *Frequency check.*

(*a*) Connect the test equipment as shown figure 4–11.

(*b*) On the test facility, set switches S17 ON and S18 to 47.50. The counter should indi- e 47.5 MHz ± 475 Hz.

(*c*) Set switch S18 to 72.50. The counter should indicate 72.5 MHz ±725 Hz.

(*d*) Set switch S17 to OFF.

NOTE

If the output frequency is outside the limits given in (*b*) and (*c*) above, proceed with (*e*) through (*k*) below.

(*e*) Extend RF oscillator board 1RE1A2–Y1 or 5TR1A2Y1 from the synthesizer using extender board, CMC 457–699, as shown in figure 4–12.

(*f*) Set switch S18 to 47.5 MHz.

(*g*) Connect the counter between TP1 (–) of rf oscillator 1RE1A2Y1 or 5TR1A2Y1 and TP3(+) of the extender board.

(*h*) Set switch S17 to ON. The counter should indicate 500 kHz ±25 Hz.

(*i*) If necessary, adjust L1 (fig. 4–13) to obtain the required frequency in (*h*) above.

(*j*) Set switch S17 to OFF and reinstall the extended board.

(*k*) Repeat (*a*) through (*d*) above. Observe the specified tolerances.

(4) *Varicap tune adjustment.*

(*a*) Extend modulator-oscillator board 1RE1A2A2 or 5TR1A2A2 from the synthesizer using extender board CMC 457–691.

(*b*) Connect the digital voltmeter between TP3(–) and TP2(+) of extender board as shown in figure 4–14A.

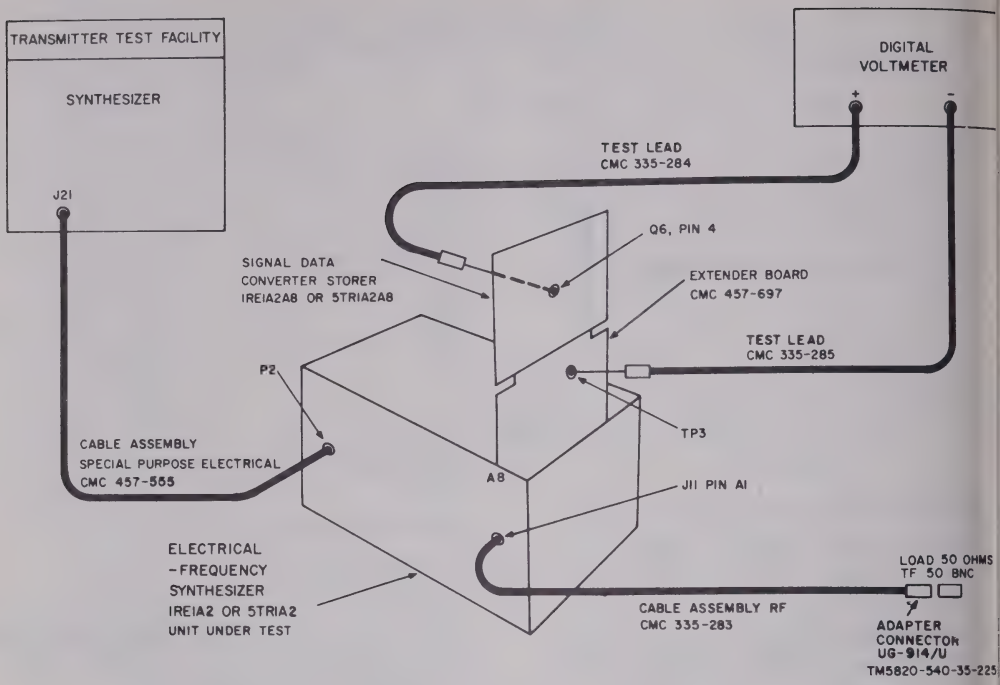


Figure 4-9. Field effect transistor, operating voltage adjustment, test setup.

(*c*) Set test facility switch S17 to ON. The digital voltmeter should indicate 8.5v ±0.2v dc.

(*d*) If necessary, adjust L3 (fig. 4–15) on 1RE1A2A2 or 5TR1A2A2 until the digital voltmeter indicates 8.5v ±0.2v dc.

(*e*) Set switch S17 to OFF. Do no reinstall the extended board.

(5) *Power output adjustment.*

(*a*) Connect the power meter to pin A1 of J11 (fig. 4–16) on the synthesizer as shown in figure 4–14B.

(*b*) Remove the cover from modulator-oscillator 1RE1A2A2 or 5TR1A2A2.

NOTE

The extender board will cause a loss of approximately 1 db. Verify output power before and after adjustments with the extender board removed and 1RE1-A2A2 or 5TR1A2A2 reinstalled in the synthesizer.

(*c*) Set switch S17 to ON. The power meter should indicate 12 dbm ±1 db.

(*d*) If necessary adjust C13 (fig. 4–15) on 1RE1A2A2 or 5TR1A2A2 for a 12 dbm ±1 db indication on the power meter.

(*e*) Set switch S18 to 47.50. The po meter should indicate 16 dbm ±2 db.

(*f*) Set switch S17 to OFF and rein the extended board.

(6) *Sync alarm adjustment.*

(*a*) Set test facility switches S18 t 48.33 and S17 to ALM 1. The SYNC lamp the test facility should light.

(*b*) If necessary, adjust R3 (fig. 4–17 amplifier-monitor board 1RE1A2A3 or 5TR1 A3 until the SYNC lamp on the test fac lights.

(*c*) Set switch S17 to ALM 2. The SY lamp should go out and after a delay it sh light again and remain lighted.

(*d*) Set switch S17 to OFF.

(7) *Deviation adjustments.*

(*a*) Connect the test equipment as sh in figure 4–18.

(*b*) Set test facility switch S20 to 30 DISCR.

(*c*) Set switch S18 to 47.50.

(*d*) Set the signal generator frequenc 77.5 MHz at a level of 0 dbm. Fine tune signal generator frequency to obtain a 50 per of full scale deflection on test facility meter

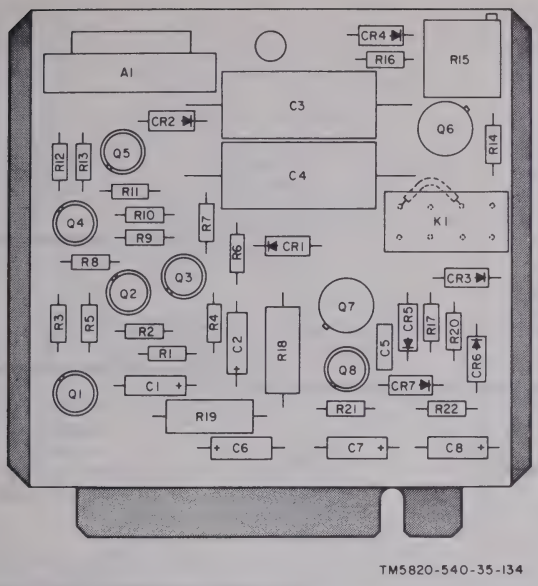


Figure 4-10. Signal data converter-storer 1RE1A2A8 or 5TR1A2A8, parts location.

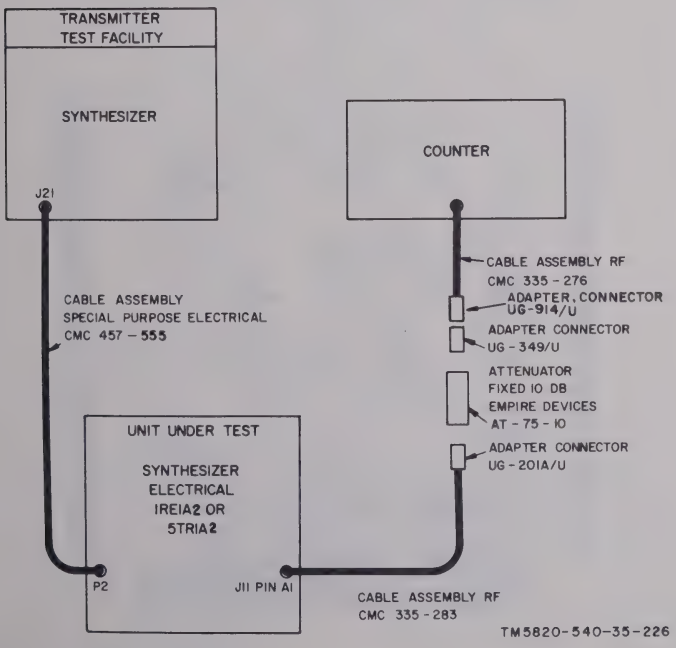


Figure 4-11. Electrical frequency synthesizer 1RE1A2 or 5TR1A2 output frequency check, test setup.

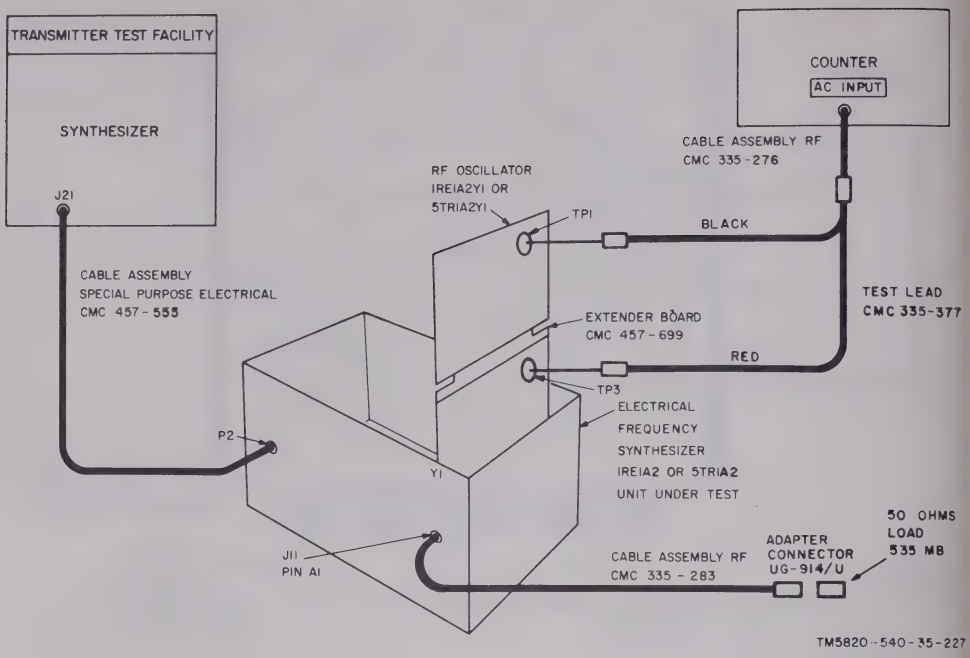


Figure 4-12. RF oscillator 1RE1A2Y1 or 5TR1A2Y1, frequency check, test setup.

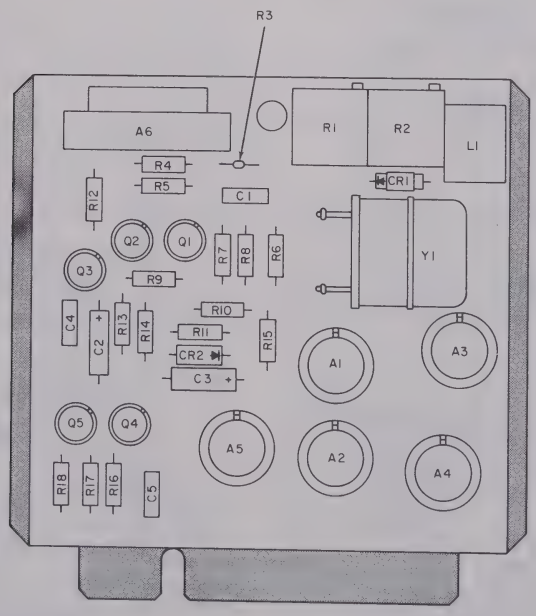


Figure 4-13. RF oscillator 1RE1A2Y1 or 5TR1A2Y1, parts location.

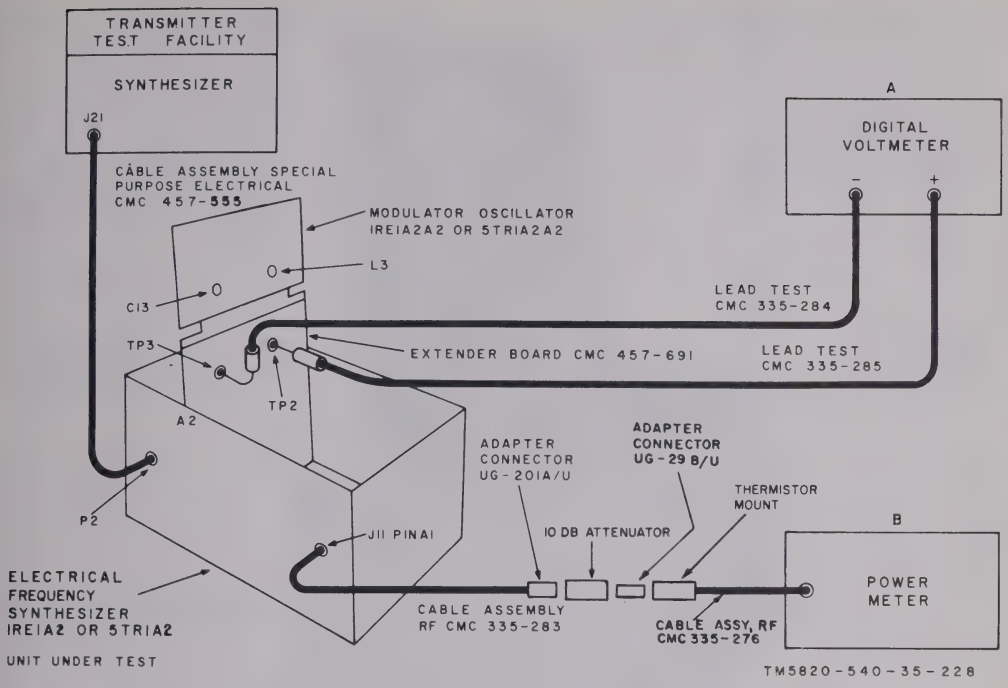


Figure 4-14. Modulator-Oscillator 1RE1A2A2 or 5TR1A2A2, varicap tuning adjustment, test setup.

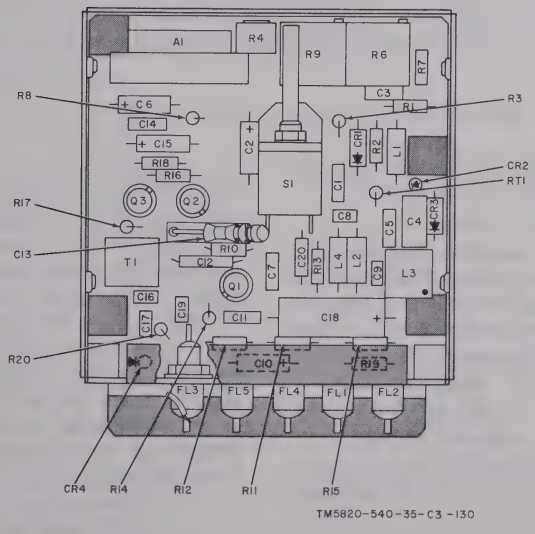


Figure 4-15. Modulator-oscillator 1RE1A2A2 or 5TR1A2A2 parts location.

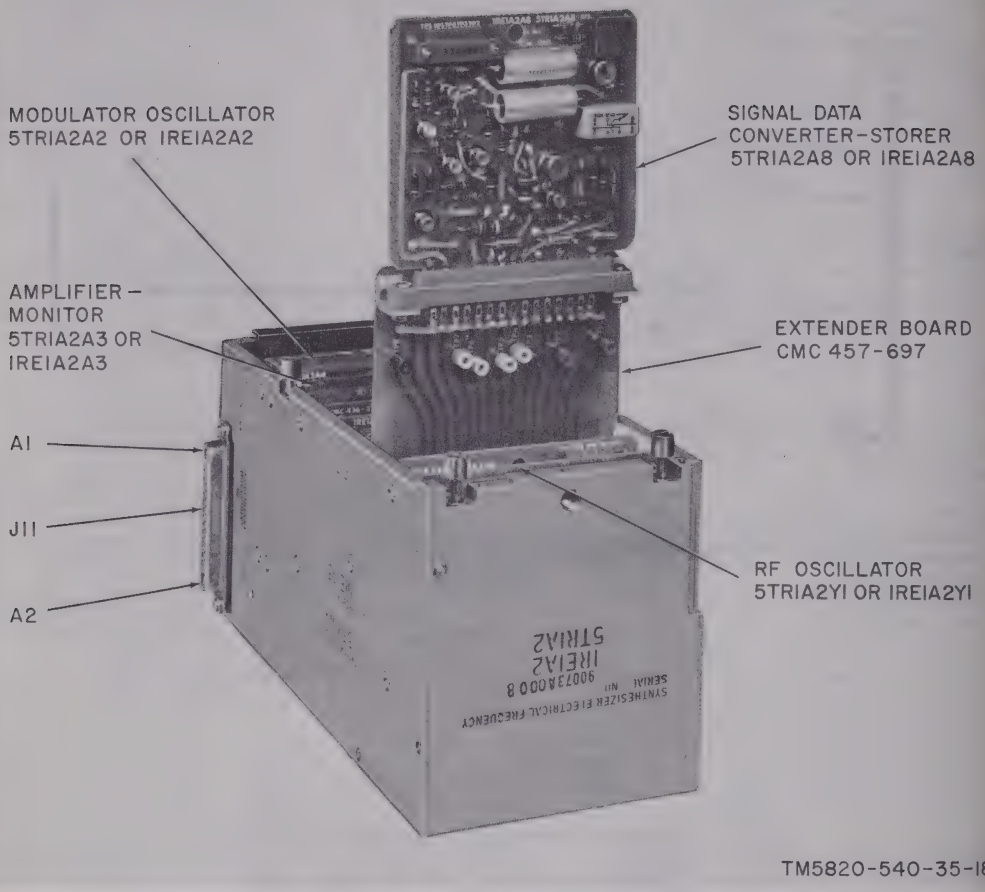


Figure 4-16. Electrical frequency synthesizer 1RE1A2 or 5TR1A2 with extended board.

readjust the signal generator output level until meter M1 indicates in the green band.

(*e*) Set switch S18 to 72.50.

(*f*) Set the signal generator frequency to 102.5 MHz at a level of 0 dbm. Fine tune the signal generator frequency to obtain a 50 percent of full scale deflection on test facility meter M2; readjust the signal generator output level until meter M1 indicates in the green band.

(*g*) Set switch S17 to the MOD ON position. The VTVM should indicate 45 mv.

(*h*) If necessary, adjust R9 (fig. 4–15) on 1RE1A2A2 or 5TR1A2A2 to obtain a 45-mv indication on the VTVM.

(*i*) Set switch S18 to 47.50.

(*j*) Set the signal generator frequency to 77.5 MHz at a level of 0 dbm. Fine tune the signal generator frequency for a 50 percent of full scale deflection on test facility meter M2; readjust the signal generator output level until meter M1 indicates in the green band. The VTVM should indicate 45 mv.

(*k*) If necessary, adjust R6 (fig. 4–15) on 1RE1A2A2 or 5TR1A2A2 to obtain the required 45-mv indication on the VTVM.

(*l*) Repeat (*c*) through (*k*) above until a 45-mv ±6 mv VTVM indication is obtained at both frequencies.

(8) *Modulation distortion check.*

(*a*) Connect the test equipment as shown in figure 4–19.

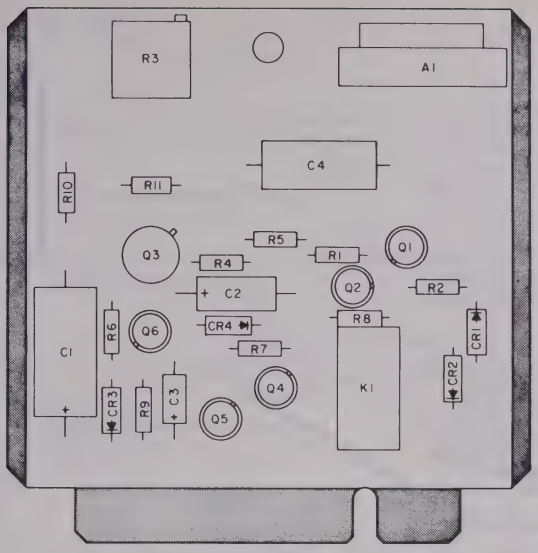


Figure 4-17. Amplifier-monitor 1RE1A2A3 or 5TR1A2A3, parts location.

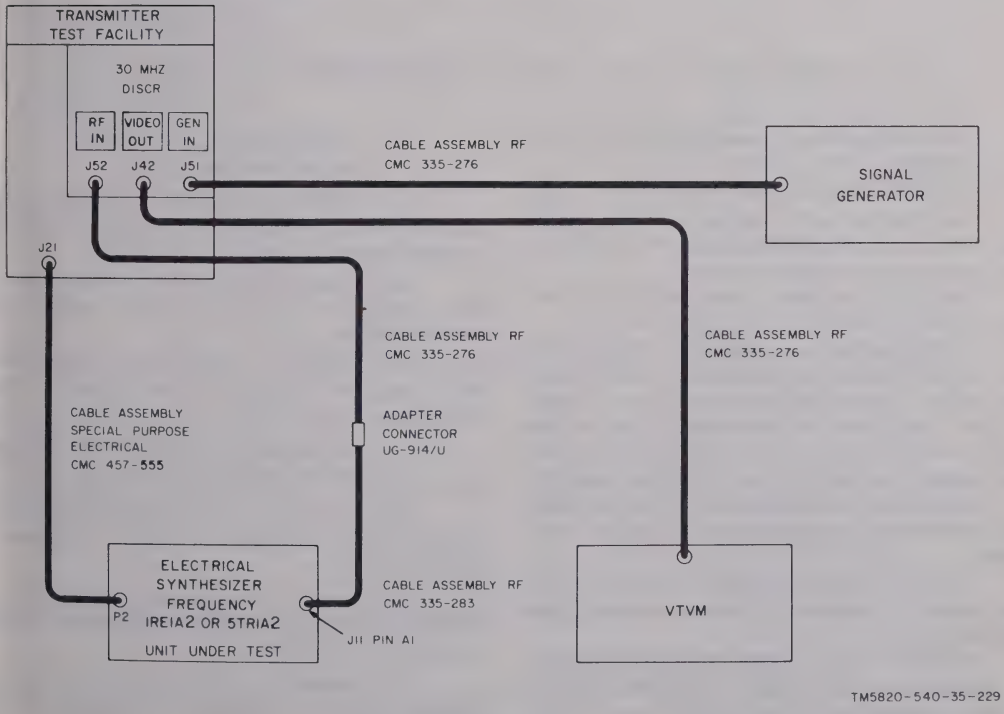


Figure 4-18. Electrical frequency synthesizer deviation adjustment, test setup.

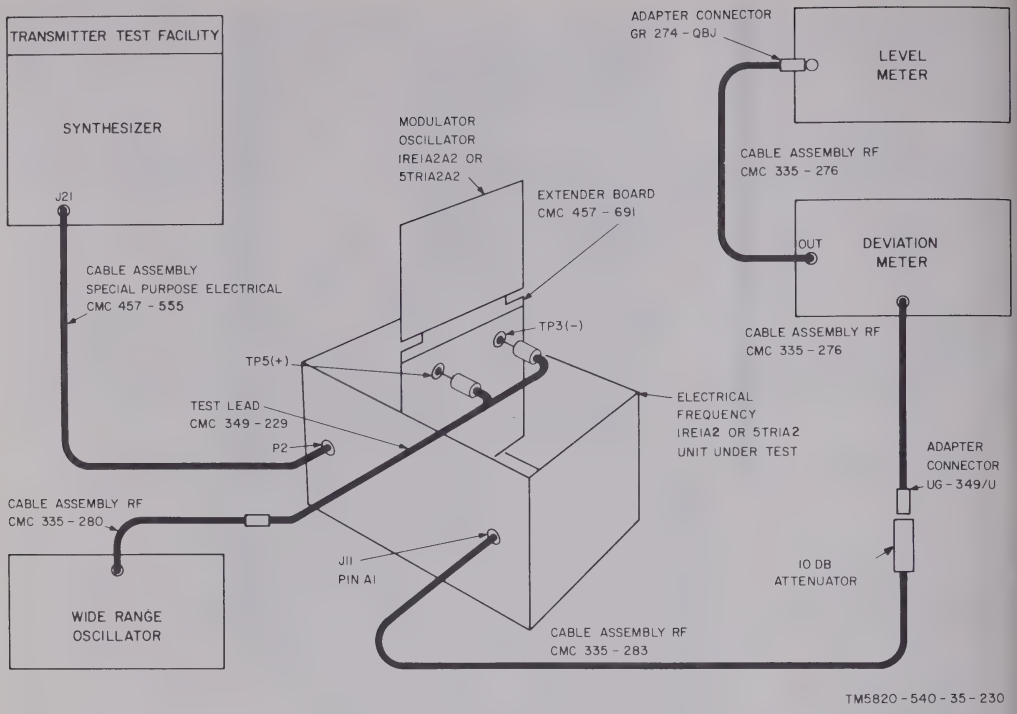


Figure 4-19. Electrical frequency synthesizer modulation distortion check, test setup.

(*b*) Set test facility switches S18 to 47.50 and S17 to ON.

(*c*) Tune the deviation meter to 47.5 MHz.

(*d*) Set the wide range oscillator to 20 kHz and adjust the output level for 45 kHz as measured on the deviation meter.

(*e*) Tune the level meter to 20 kHz and peak up on the signal. Note the level.

(*f*) Tune the level meter to 40 kHz and peak up on signal. The indication should be at least 26 db below that obtained in (*e*) above.

(9) *Fault isolation procedure.* If any of the requirements of (3) through (8) above are not met, isolate the fault in the following manner.

(*a*) Remove all boards from the synthesizer and insert a complete set of known good boards.

(*b*) If the synthesizer still fails to function properly, troubleshoot the synthesizer case (*c* below).

(*c*) If the fault clears when the complete set of known good boards is installed, isolate the faulty board(s) of the original set in the following manner:

1. Remove known good board.

2. Insert original board.

3. Check for proper synthesizer opera tion. If normal indications are obtained with th original board proceed to (*d*) below.

(*d*) Repeat (c) above for every board i the synthesizer in case more than one origina board is faulty.

(*e*) Repeat (*c*) above with switch S18 a 72.50 and the signal generator tuned to 102 MHz as in (7) (*f*) above.

(*f*) Set switch S17 to the MOD ON pos tion. The VTVM should indicate 40 mv.

(*g*) If necessary, adjust R9 on 1RE1A2A or 5TR1A2A2 to obtain a 40-mv indication o the VTVM.

(*h*) Repeat (*c*) above and adjust R6 o 1RE1A2A2 or 5TR1A2A2 to obtain a 40-mv ind cation on the VTVM.

(*i*) Repeat (*e*), (*g*), and (*h*) above unt a 40-mv ±6 mv indication is obtained on th VTVM.

. *Troubleshooting.*

Symptom	Probable cause	Checks and corrective measures
Modulator-oscillator 1RE1A2A2 or 5TR1A2A2 (figs. 6-3 and 4-15).		
SYNC alarm on test facility; No output from synthesizer.	Open or shorted component	To isolate the defective stage, measure the voltages and observe the waveforms listed in *d*(1) below.
Wrong synthesizer output frequency and/or SYNC alarm on test facility.	Defective oscillator stage	Measure the voltages and observe the waveforms listed in *d*(1) below.
Low level from synthesizer	Component changed value in Q1, Q2, or Q3 oscillator stages.	To isolate the defective stage, measure the voltages and observe the waveforms listed in *d*(1) below.
Amplifier-monitor 1RE1A2A3 or 5TR1A2A3 (figs. 2-17 and 4-17).		
SYNC alarm on test facility.	*a*. Loss of afc due to defective Q1 or Q2 stage.	*a*. To isolate the defective stage, measure the voltages listed in *d*(2) below.
	b. Loss of clock pulse D due to defective Q6 stage.	*b*. Measure the voltages and observe the waveforms listed in *d*(2) below.
	c. Defective relay K1	*c*. Measure voltage between TP3(–) and TP1(+) of extender board. It should be 21.5 volts dc. Measure the remaining voltages listed in *d*(2) below.
Frequency divider 1RE1A2A4 or 5TR1A2A4 (fig. 2-4 and 4-20).[a]		
SYNC alarm on test facility.	Defective amplifier or divider stage	To isolate the defective stage, observe waveforms shown in *d*(3) below.
Digital electronic divider-counter 1RE1A2A5 or 5TR1A2A5 (fig. 6-9 and 4-21).		
Wrong synthesizer output frequency and/or SYNC alarm on test facility.	*a*. Defective transistor stage	*a*. Observe waveforms at collectors of Q1 thru Q6, shown in *d*(4) below. If waveform is not as shown check the resistance of associated resistor. If resistance is normal, replace transistor.
	b. Defective counter A1 through A6.	*b*. Observe waveforms at pin 3 of binaries A1 through A6, listed in d(4) (*d*) below. Observe waveforms at pin 3 of binaries A1 thru A6, listed in d(4)(*b*) below.
SYNC alarm on test facility.	Defective divider stage A7, A8 or A9	To isolate the defective stage, observe the appropriate waveforms listed in *d*(4) below.
) Digital electronic counter. 1RE1A2A6 or 5TR1A2A6 (figs. 6-8 and 4-22).		
Frequency error from synthesizer of 1.0 MHz or less.	*a*. Defective AND gate Q1 through Q6.	*a*. To isolate the defective AND gate, observe the waveforms at pin 7 of binaries A4 through A9 listed in *d*(5) below.
	b. Defective resistor R1 through R6.	*b*. Disconnect board and measure resistance of each resistor.
SYNC alarm on test facility.	*a*. Defective binary A1 through A9	*a*. To isolate the defective binary, observe the waveforms at pin 3 of binaries A1 through A9 listed in *d*(5) below.
	b. Defective diode CR1 through CR6.	*b*. Observe waveform at TP7 extender board, listed in *d*(5) below.
	c. Defective NOR gate A10	*c*. Observe the waveforms at pins 2, 3, 7, 8, 9 and 10 of NOR

Symptom	Probable cause	Checks and corrective measures
		gate A10 listed in *d*(5) below.
(6) Electrical synchronizer 1RE1A2A7 or 5TR1A2A7 (fig. 6-7 and 4-23). Defective components can be isolated by observing the waveforms listed in *d*(6) below.		
(7) Signal data converter storer 1RE1A2A8 or 5TR1A2A8 (fig. 2-15 and 4-10).		
Wrong frequency from synthesizer.	CR1 shorted	Check CR1 resistance.
Synthesizer will not increase in frequency.	Break in signal path between contact 11 of J8 and TP3.	To isolate the defective stage, measure the voltages and observe the waveforms listed in *d*(7) below.
Synthesizer locked at a high synthesizer frequency.	CR2 shorted	Check CR2 resistance.
Synthesizer will not decrease in frequency.	Break in signal path between contact 10 of J8 and TP3.	To isolate the defective stage, measure voltages and observe waveforms listed in *d*(7) below.
(8) Frequency divider 1RE1A2A9 or 5TR1A2A9 (figs. 6-6 and 4-24)		
SYNC alarm on test facility	Defective binary	To isolate the defective binary, observe the waveforms listed in *d*(8) below.
(9) RF oscillator 1RE1A2Y1 or 5TR1A2Y1 (fig. 6-5 and 4-12)[b]		
Wrong frequency from synthesizer or SYNC alarm on test facility when switch S18 of test facility is at 48.33, 54.98, 61.66, 67.50 or 72.50 positions. Other positions of S18 normal.	Divide-by-3 function inoperative	Measure the voltages at Q4 and Q5 stages and observe the waveforms at binaries A3 and A4, and gates A2 and A5 listed in *d*(9) below.
SYNC alarm on test facility or wrong frequency from synthesizer at all positions of S18 on test facility.	Defective divider or oscillator stage.	To isolate defective stage, observe remaining waveforms listed in *d*(9) below and perform resistance checks at the oscillator section.
(10) Interconnecting box 1RE1A2A1A1 or 5TR1A2A1A1 (figs. 6-11 and 4-25).		
SYNC alarm on test facility or wrong frequency from synthesizer.	Defective wiring or component	Disconnect synthesizer from test facility. Remove all plug-in-circuit boards and make resistance measurements. Measure voltages listed in *d*(10) below.

d. Typical Voltage Measurements and Oscilloscope Displays.

(1) *Modulator-oscillator 1RE1A2A2 or 5TR1A2A2* (fig. 4–15).

(*a*) Typical signal voltage indications using the allocated oscilloscope and test facility switch S18 at 47.50:

Test points	Typical indications (volts ac peak-to-peak)
Center tap of L3	0.7
Q1 base	0.7
Q1 collector	2.6
Q2 collector	0.8
Q3 collector	9.0
TP7 of extender board	4.0

(*b*) Typical dc voltage indications using the digital voltmeter, with the synthesizer programed for 47.5 MHz:

Test points	Typical indications (volts dc)
Junction L1 and CR2	2.50
Junction C4 and CR3	2.10
Q1 emitter	7.40
Q1 base	8.10
Q1 collector	9.17
Q2 base	0.76
Q2 collector	1.60
Q3 emitter	0.84
Q3 base	1.58
Q3 collector	1.20
TP2(+) and TP3(−) of extender board.	1.30

(2) *Amplifier monitor 1RE1A2A3 or 5TR 1A2A3* (fig. 4–17).

(*a*) Typical dc voltage indications usi the digital voltmeter, and with test facility swit S18 at 47.50.

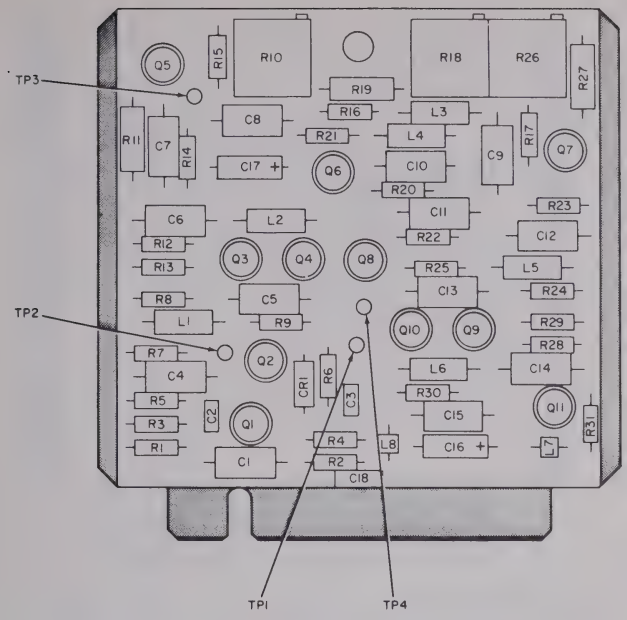


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Figure 4-20. Frequency divider 1RE1A2A4 or 5TR1A2A4, parts location.

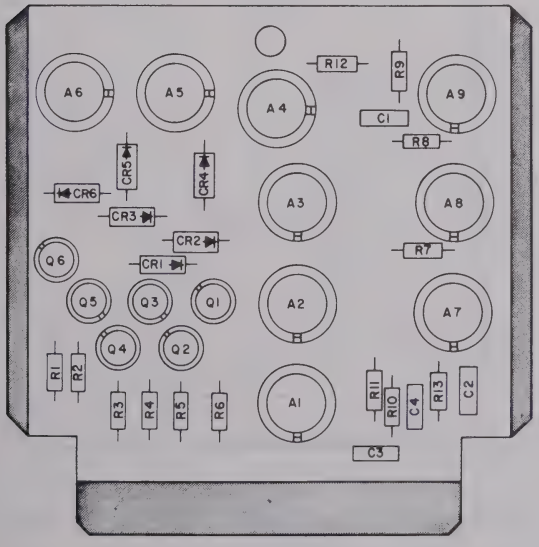

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Figure 4-21. Digital electronic divider-counter 1RE1A2A5 or 5TR1A2A5, parts location.

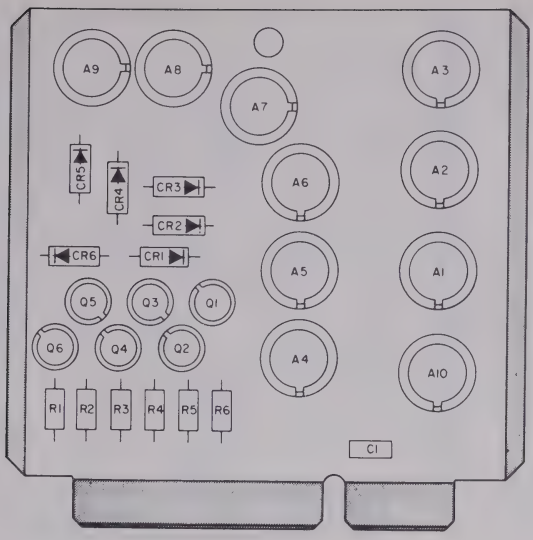

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Figure 4-22. Digital electronic counter 1RE1A2A6 or 5TR1A2A6 parts location.

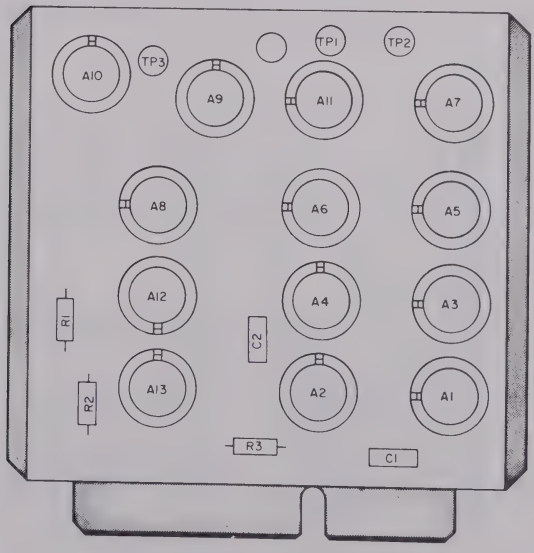

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Figure 4-23. Electrical synchronizer 1RE1A2A7 or 5TR1A2A7, parts location.

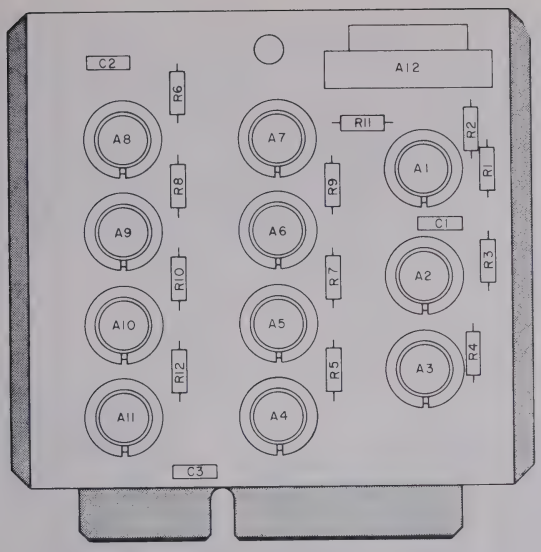


Figure 4-24. Frequency divider 1RE1A2A9 or 5TR1A2A9, parts location.

Test points	Typical indications (volts dc)
TP1(–) to TP2(+)	1.25
TP1(–) to TP3(+)/Q5 collector	6.50
TP1(–) to TP4(+)/Q3 collector	2.20
Pin 11, J4	2.37
Q1 base	2.37
Q1 emitter/Q2 base	1.83
Q3 base/Q2 collector	23.00
Q3 emitter	23.70
Q4 base	0
Q4 collector/Q5 base	0.66
Junction C2 and CR4	1.37

(*b*) A typical signal voltage indication sing the allocated oscilloscope, with test facility vitch S18 at 47.50, is shown in figure 4–197(1).

(3) *Frequency divider 1RE1A2A4 or 5TR–A2A4* (fig. 4–20). Typical signal voltage indications using the allocated oscilloscope, with test acility switch S18 at 66.00, are shown in figure -197(2).

(4) *Digital electronic divider-counter 1RE1-2A5 or 5TR1A2A5* (fig. 4–21).

(*a*) Typical signal voltage indications sing the allocated oscilloscope, with test facility switch S18 at 66.00, are shown in figure -197(3).

(*b*) Typical signal voltage indications sing the allocated oscilloscope triggered by the signal at TP1 of 1RE1A2A7 or 5TR1A2A7, with test facility switch S18 at 66.00 are shown in figure 4–197(4). All waveforms are 4 volts peak-to-peak.

(*c*) Typical voltage indications using the allocated oscilloscope, with test facility switch S18 at OFF, are shown in figure 4–197(5).

(*d*) Check pulse action on binaries. With the oscilloscope triggered by the signal at TP1 of 1RE1A2A7 or 5TR1A2A7, and with test facility switch S18 at OFF, typical indication is shown in figure 4–197(6).

(5) *Digital electronic counter 1RE1A2A6 or 5TR1A2A6* (fig. 4–22).

(*a*) Typical voltage indications using the allocated oscilloscope and with test facility switch S18 at 66.00, are shown in figure 4–198 (7).

(*b*) Check pulse action on binaries. With the oscilloscope triggered by the signal at TP1 of 1RE1A2A7 or 5TR1A2A7; short circuit between TP2 and TP4 of extender board; with test facility switch S18 at 66.00, typical voltage indications are shown in figure 4–197(8).

(6) *Synchronizer electrical 1RE1A2A7 or 5TR1A2A7* (fig. 4–23).

(*a*) Typical voltage indications using the allocated oscilloscope triggered by signal at binary A7 pin 7, with test facility switch S18 at 66.00, are shown in figure 4–197(9).

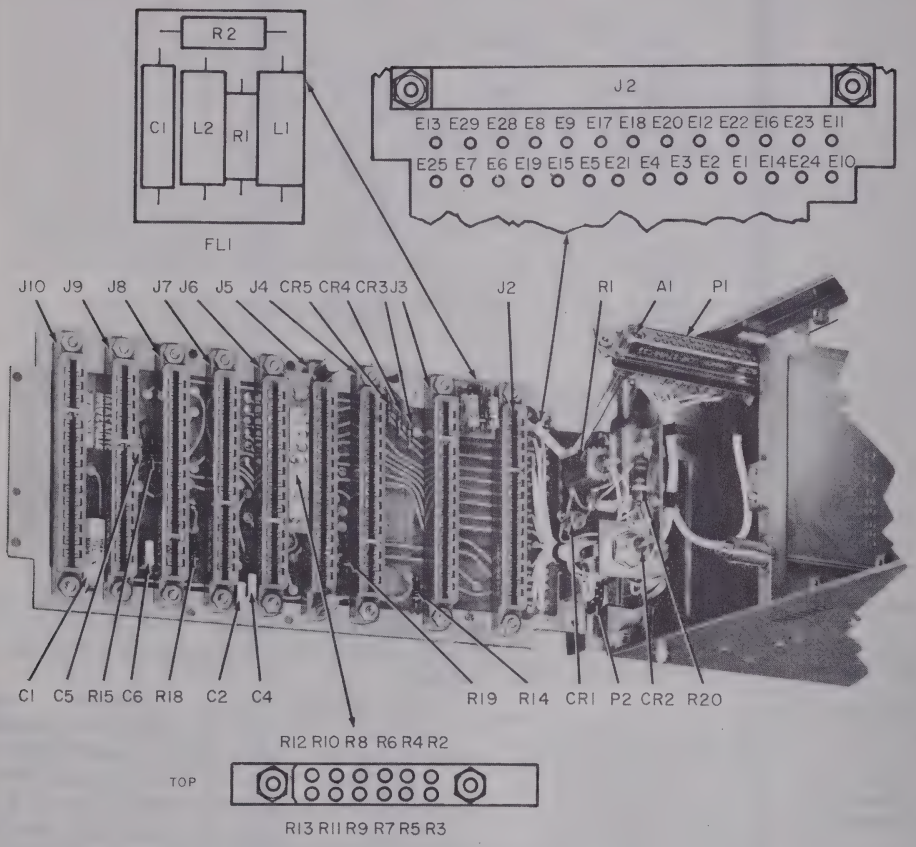


Figure 4-25. Interconnecting box 1RE1A2A1 or 5TR1A2A1.

(*b*) With facilty switch S18 at 48.33, and switch S17 at ALM 2, a typical voltage indication is shown in figure 4–197(10).

(*c*) With test faciilty switch S18 at 54.98, and switch S17 at ALM1, typical voltage indications are shown in figure 4–197(11).

(7) *Signal data converter-storer 1RE1A2A8 or 5TR1A2A8* (fig. 4–10).

(*a*) Typical voltage indications, using the digital voltmeter and the allocated oscilloscope triggered by the signal at TP6 of the extender board, with test facility switch S18 at 48.33, and switch S17 at ALM 2, are shown in figure 4–197(12). The SYNC lamp should light.

(*b*) Typical oscilloscope indications, tri gered by the signal at TP7 of the extender boar with test facility switches S18 at 54.98 and S at ALM 1, are shown in figure 4–197 (13). T SYNC lamp should light.

(8) *Frequency divider 1RE1A2A9 or 5TR 1A2A9* (fig. 4–24). Typical waveforms, usi the allocated oscilloscope, are shown in figu 4–197(14).

(9) *RF oscillator 1RE1A2Y1 or 5TR1A2Y* (fig. 4–12).

(*a*) Typical waveforms and volta measurements, using the allocated oscilloscop and the digital voltmeter, with test facili

tch S18 at 48.33, are shown in figure 4–197).

(*b*) With test facility switch S18 at 47.50, ical voltages and waveforms are shown in ure 4–197(16).

(10) *Interconnecting box 1RE1A2A1A1 or R1A2A1A1* (fig. 4–25). Remove all plug-in cuit boards; set test facility switch S17 at N. Check the voltages between the following t points:

Test points	Typical indication (volts dc)
E30 (+) to E9 (–)	20
E28 (+) to E9 (–)	16

20. Alarm Control 5TR1A3

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V).	Transmitter test facility
Accessory Kit. Test Facilities Set MK-1173(V)1/ GRM-95(V).	Accessory kit
Voltmeter, Digital AN/GSM-64	Digital voltmeter
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) Connect the test equipment as shown figure 4–26, but do not connect the unit der test to the test facility.

(2) Set the digital voltmeter to the 1-volt ale. Set test facility switches S1 and S25 to their N positions.

(3) Adjust the test facility SET INPUT control to give a 0.5-v indication on the digital voltmeter.

(4) Connect the unit under test (fig. 4–27) to test facility connector J33. The digital voltmeter should indicate at least 460 mv. The test facility control alarm lamp should be out.

(5) Adjust the SET INPUT control to obtain a 120-mv indication on the digital voltmeter.

(6) On the module under test, adjust potentiometer R7 until the control alarm lamp lights.

(7) Adjust the SET INPUT to obtain a 170-mv indication on the digital voltmeter. The control alarm lamp should go out.

c. Troubleshooting (fig. 6–40).

Symptom	Checks and corrective measures
Incorrect meter reading; Test facility control alarm lamp lights.	Measure the voltage at CR2, CR3, CR4, Q1, and Q2 (fig. 4-28) and 6-40) as described in *d* below.
Correct meter reading; control alarm lamp lights.	Measure the voltage at Q3 and Q4 (*d* below). Check relay K1 as described below.
Normal indications; but control alarm lamp does not light.	Check relay K1 contacts for continuity (between E1 and E2 terminals). Replace if contacts are sticking.

d. Voltage and In-Circuit Resistance Measurements.

(1) *Voltage measurements.*

Test point	Typical indication (v dc)	Probable cause of incorrect result	Corrective action
unction of CR2 and CR3	+19.5	Faulty diodes	Check forward and reverse resistance of diodes. Replace if necessary.
unction of CR4 and R11	+6.0	Faulty diode	Same as above.
1-Emitter	+0.1	Faulty transistor stage	Measure resistance of R7, Q1, and Q2 ((2) below).
-Base	+0.12		Replace transistor or resistor as required.
2-Collector	+1.8		
3-Emitter	+2.5	Faulty transistor stage	Measure resistance of Q3 and Q4 to isolate stage.
-Collector	+2.3		Refer to resistance chart ((2) below).
4-Emitter	–5.4		
-Base	–4.6		
-Collector	–4.7	K1 defective	Check relay operation.

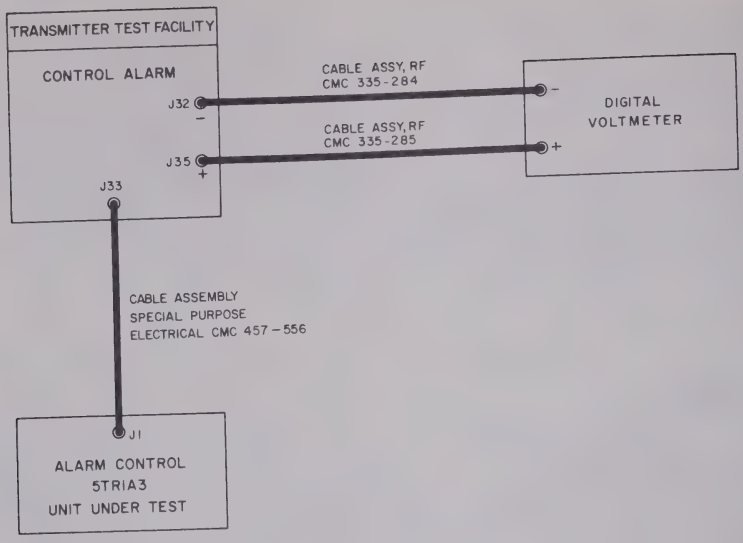


Figure 4-26. Alarm control 5TR1A3, test setup.

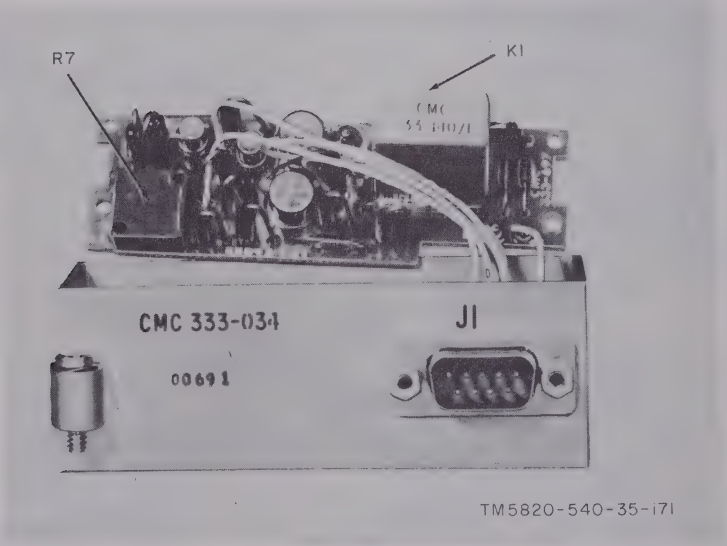


Figure 4-27. Alarm control 5TR1A3, cover removed.

NOTE

All resistances measured with allocated multimeter.

(2) *In-circuit resistance measurements.*

Stage and transistor type	Base (−)				Base (+)			
	Emitter (+) Resistance (ohms)	Range	Collector (+) Resistance (ohms)	Range	Emitter (−) Resistance (ohms)	Range	Collector (−) Resistance (ohms)	Range
Q1 (2N930)	17k	10k	2k	x 100	850	x 100	750	x 100
Q2 (2N930)	Infinity	10k	Infinity	x 10k	900	x 100	800	x 100
Q3 (2N1132)	850	x 100	850	x 100	8.5k	x 100	Infinity	x 10k
Q4 (2N697)	Infinity	10k	Infinity	x 10k	800	x 100	750	x 100

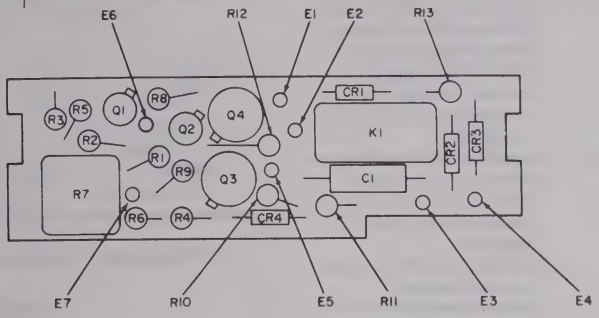


Figure 4-28. Alarm control 5TR1A3A1, parts location.

4-21. Amplifier-Frequency Multiplier 5TR1A4

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V).	Accessory kit
Generator, Signal SG-888/U	Sweep generator
Wattmeter, AN/URM-98	Multimeter
Multimeter, TS-352B/U	Multimeter
Oscilloscope, AN/USM-281	Oscilloscope

b. Test Procedure.

(1) Connect the test equipment as shown in figure 4-29.

(2) Set the test facility switches as follows:

Switch	Switch position	Normal indication
S12	ON	
S1	ON	
S20	S30	
S30	ON	
S17	ON	
S18	47.50	Power meter should indicate +35 dbm, −1.0 db, +1.5 db. Meter M1 on test facility should not exceed 100%.

(3) Set switch S18 to all frequencies in turn. The power meter should indicate +35 dbm, −1.0 db, +1.5 db.

(4) If an unstable output is obtained realign the module as described in *e* below.

c. Troubleshooting (fig. 6-12).

Symptom	Checks and corrective measures
No output, no meter M1 indication (para *b* (2) above).	Check +28v dc supply at L10, L12, and L16; investigate any abnormal indication; replace components as required (fig. 4-30).
	Set test facility switch S18 to 47.5. Using oscilloscope check the input signal at E1 and E3 (5TR1A4FL1); refer to chart below. If signal not present at E3 check continuity of L1 through L4 (5TR1A4FL1). Replace components as required (fig. 4-31).
	Check connector and cable A1 of P1 to E1 (5TR1A4FL1), repair or replace cable and connector.
	If signal normal at E3 (5TR1A4FL1), check signal through transistor stages (chart below). If signal at Q1 is abnormal, check continuity of T1 wind-

Symptom	Checks and corrective measures
	ings, and forward and reverse resistances of CR1 diodes. If problem is isolated to transistor stage, check voltages and resistances. Refer to paragraph *d* below for transistor resistance measurements. If transistor stages check normal, check continuity of components from Q3 through E9 and cable from E9 to connector A2 of P1 for short-circuit. Repair or replace components as required.
Output normal, no meter M1 indication.	Check CR1 for possible short-circuit, and L17 and R17 for open circuit; replace components as required.
Excessive output	Check R1 and R2 for open circuit; resolder connections if loose.
Low output	Using oscilloscope, check gain of transistor stages. Refer to chart below. Check components

Symptom	Checks and corrective measures
	in isolated stage and replace as required. Check continuity of components from Q3 through A2 of P1. Replace or repair as required. Check alignment and frequency response. Refer to paragraph *e* below.

Test points	Typical indication
E1	3.0v peak-to-peak
E3	3.0v peak-to-peak
Q1-Base	250 mv peak-to-peak
-Collector	875 mv peak-to-peak
Q2-Base	750 mv peak-to-peak
-Collector	4.0v peak-to-peak
Q3-Base	2.5v peak-to-peak
-Collector	4.0v peak-to-peak

d. Transistor Resistance Measurements.

NOTE

All resistances measured with the allocated multimeter.

Stage	Transistor		Base (−)				Base (+)			
			Emitter (+)		Collector (+)		Emitter (−)		Collector (−)	
	Ref.	Type	Res. (ohms)	Multimeter range	Res. (ohms)	Multimeter range	Res. (ohms)	Multimeter range	Res. (ohms)	Multimeter range
	Q1	2N3866	1300	x 100	3000	x 100	950	x 100	950	x 100
	Q2	2N3866	1300	x 100	3000	x 100	950	x 100	950	x 100
	Q3	2N3375	0	x 100	1200	x 100	0	x 100	650	x 100

e. Alignment—Frequency Response.

(1) Calibrate the sweep generator output level to +12 dbm through the frequency range of 47 to 75 MHz, with the function switch set to SWEEP.

(2) Remove the protection caps from the tuning capacitors. Replace the covers on the module under test during alignment.

(3) Connect the test equipment as shown in figure 4–32.

(4) Set test facility switches S1 to ON; S20 to S30; and S30 to ON.

(5) Set the controls on the unit under test as follows (fig. 4–33).

Control	Position
C31	Fully ccw—minimum capacitance
C35	Fully cw—maximum capacitance
C36	Fully cw—maximum capacitance
C27	Fully cw—than 2 turns ccw
C14	Fully cw—then 2 turns ccw
C26	Midrange
C22	Fully cw—then 3 turns ccw
R1	Fully ccw—maximum resistance
R2	Fully ccw—maximum resistance

(6) On the sweep generator, set the swee width control to maximum and the sweep di to 72 MHz.

(7) On the unit under test, adjust C ccw until the response at 72.5 MHz reaches maximum. Use the sweep generator markers determine the frequencies.

NOTE

C35 should not be adjusted to its minimum capacitance position.

(8) Turn the sweep generator dial to 4 MHz.

(9) Adjust C36 for a response cut off b tween 46 and 47 MHz as shown in figure 4–3

(10) Adjust C26 for maximum output a 46.5 MHz.

(11) Set test facility switch S30 to OFF.

(12) Repeat the test procedure described i *b* above.

(13) Set switch S30 to OFF.

f. Alignment, Harmonic Rejection.

(1) Connect the test equipment as show in figure 4–35.

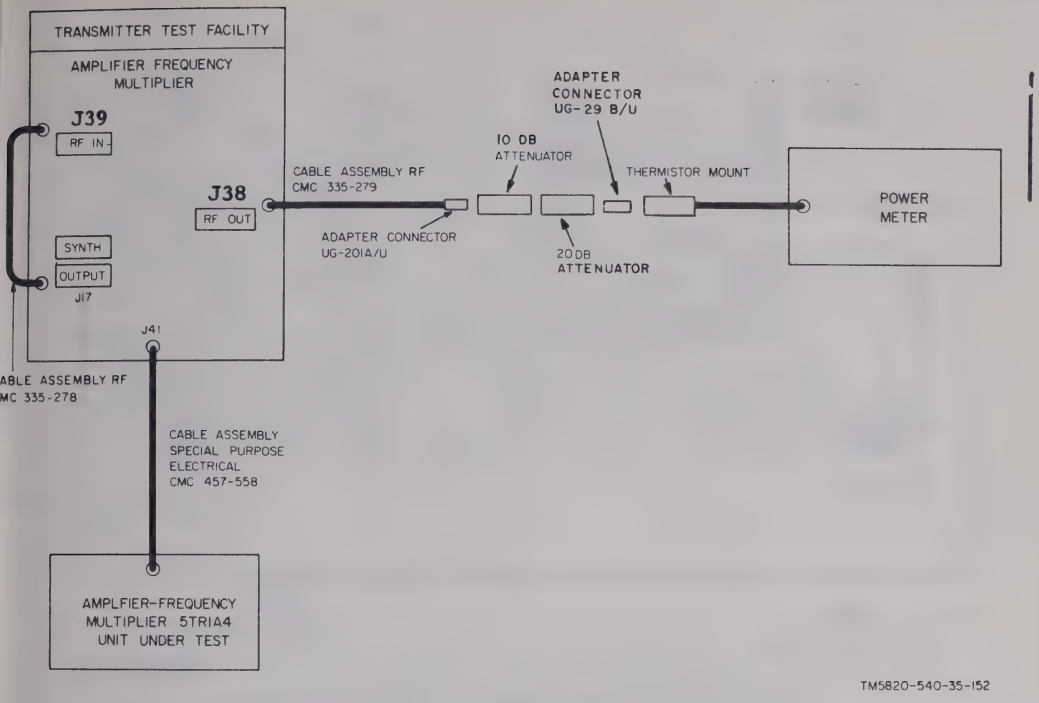


Figure 4-29. Amplifier-frequency multiplier 5TR1A4, test setup.

(2) Set the sweep generator to +12 dbm 48.0 MHz and the 95–190 MHz filter to 144 Hz.

CAUTION

Do not tune the filter below 100 MHz. This will damage the power meter.

(3) Set test facility switch S30 to ON. The ver meter should indicate less than –10 dbm.

(4) On the unit under test adjust R1 and for minimum indication. Record the level.

NOTE

The positions of R1 and R2 should be as far clockwise s possible.

(5) Tune the sweep generator through to MHz, simultaneously maintaining the filter at 3d harmonic of the fundamental. The ampli-e of the 3d harmonic should be less than the el recorded in (4) above. R1 and R2 may be djusted to minimize any excessive indication.

(6) Tune the sweep generator to 47.5 MHz l the tunable filter to 190 MHz; slightly ad-t C35 to minimize the 4th harmonic indication. e power meter should indicate below –17 dbm.

(7) Set switch S30 to OFF.

(8) Replace the 95 to 190 MHz filter, with the 43 to 95 MHz filter set to 48 MHz.

(9) Set switch S30 to ON.

(10) Tune the sweep generator from 48 MHz to 72.5 MHz, and at the same time tune the tunable filter from 48 MHz to 72.5 MHz. The fundamental level should be lower than the indication obtained in (4) above.

4–22. Amplifier Monitor 5TR1A5

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility Transmitter TS-2866(V)1/ GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V).	Accessory kit
Voltmeter, El ectronic ME-30A/U.	VTVM
Generator, Signal AN/USM-205.	Wide range oscillator
Multimeter TS-352B/U	Multimeter
Oscilloscope AN/USM-140.	Oscilloscope

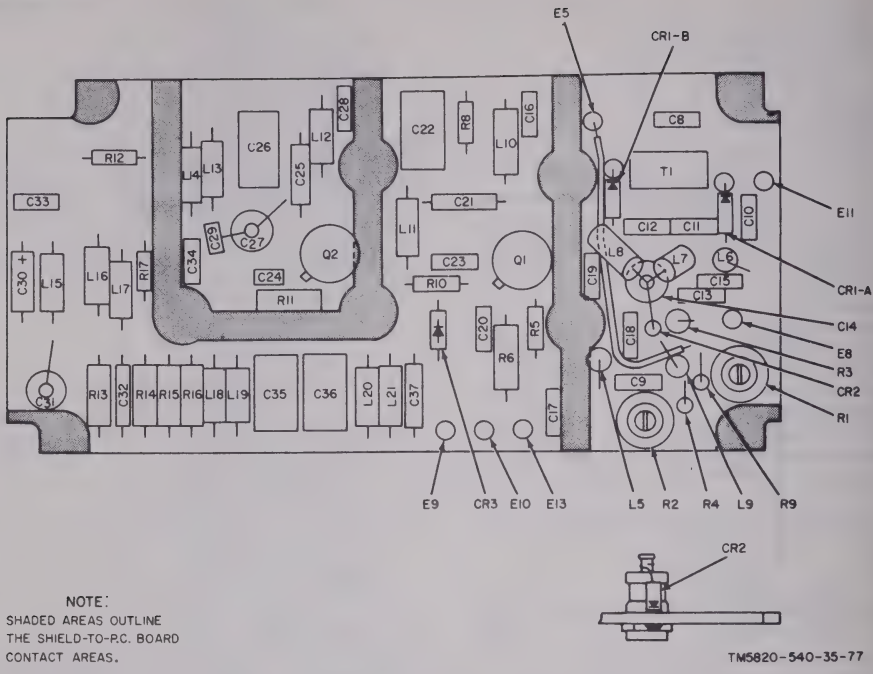


Figure 4-30. Amplifier-frequency multiplier 5TR1A4A1, parts location.

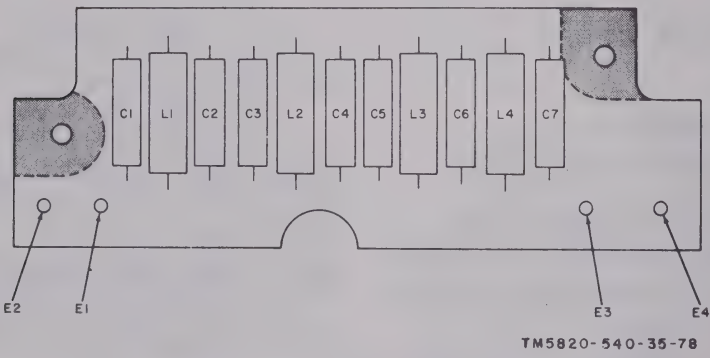


Figure 4-31. Low pass filter 5TR1A4FL1 or 1RE1A5FL1, parts location.

b. Test Procedure.

(1) *Amplifier gain test.*

(*a*) Connect the test equipment as shown in figure 4–36.

(*b*) Set the test facility switches as follows:

Switch	Position
S1	ON
S20	S28
S28	OW
S29	INPUT

(*c*) Adjust the wide range oscillator to 0 kHz at 246 mv (–10 dbm) as shown on e VTVM.

(*d*) Set test facility switch S29 to OU- PUT. The VTVM should indicate 32 mv ±1 r.

(*e*) If necessary adjust R26 (fig. 4–37) o obtain the value given in (*d*) above.

(2) *Relays and attenuator operation.*

(*a*) Using the test setup shown in fig e 4–36, set test facility switch S28 to 0 db.

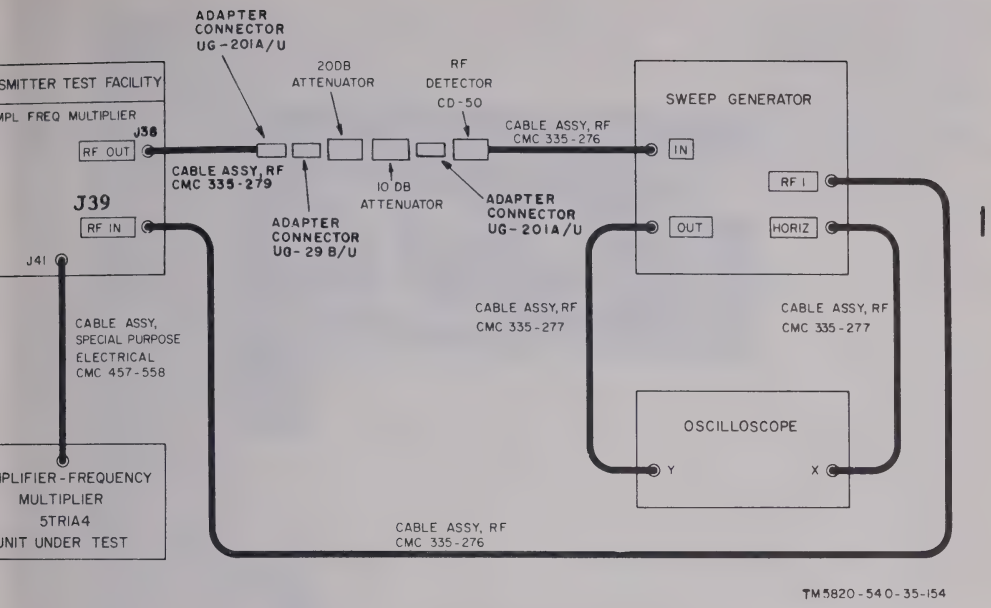


Figure 4-32. Amplifier-frequency multiplier 5TR1A4, frequency response, test setup.

(*b*) Adjust the wide range oscillator out-ntrol to obtain a –10 db indication on the

(*c*) Set test facility switch S28 to 3.5 db. TVM should indicate –13.5 db ±0.5 db.
(*d*) Set switch S28 to 6.0 db. The VTVM indicate –16.0 db ±0.5 db.
(*e*) Set switch S28 to 12.0 db. The VTVM indicate –22 db ±0.5 db.
) *Metering circuits.*
(*a*) Using the test setup shown in figure et test facility switches S28 to FDM and OUTPUT.
(*b*) Adjust the output of the wide scillator until the VTVM indicates 53 mv. cility meter M1 should indicate 50 percent scale deflection.
(*c*) If necessary, on the unit under test, R12 (fig. 4–38) to obtain the indication n (*b*) above.
(*d*) On the test facility, set switch S28 to AN. Adjust the wide range oscillator out-a 128-mv indication on the VTVM. Meter uld indicate 50 percent of full scale de-.
(*e*) If necessary, on the unit under test, R11 (fig. 4–38) to obtain the indication n (*d*) above.

(*f*) Set test facility switch S28 to 24 CHAN. Adjust the wide range oscillator output for a 212-mv indication on the VTVM. Meter M1 should indicate 50 percent of full scale deflection.

(*g*) If necessary, on the unit under test, adjust R10 (fig. 4–38) to obtain the indication given in (*f*) above.

(4) *Frequency Response.*

(*a*) Using the test setup shown in figure 4–36, set test facility switches S28 to FREQ RESP and S29 to OUTPUT.

(*b*) Tune the wide range oscillator output frequency to 10 kHz and adjust its output level to obtain a 200-mv indication on the VTVM.

(*c*) Vary the frequency of the wide range oscillator from 10 kHz to 960 kHz. The output as indicated on the VTVM should remain constant within the limits below.

Frequency range	Output variation (mv)
10 kHz to 565 kHz	±10
565 kHz to 850 kHz	±15
850 kHz to 960 kHz	±30

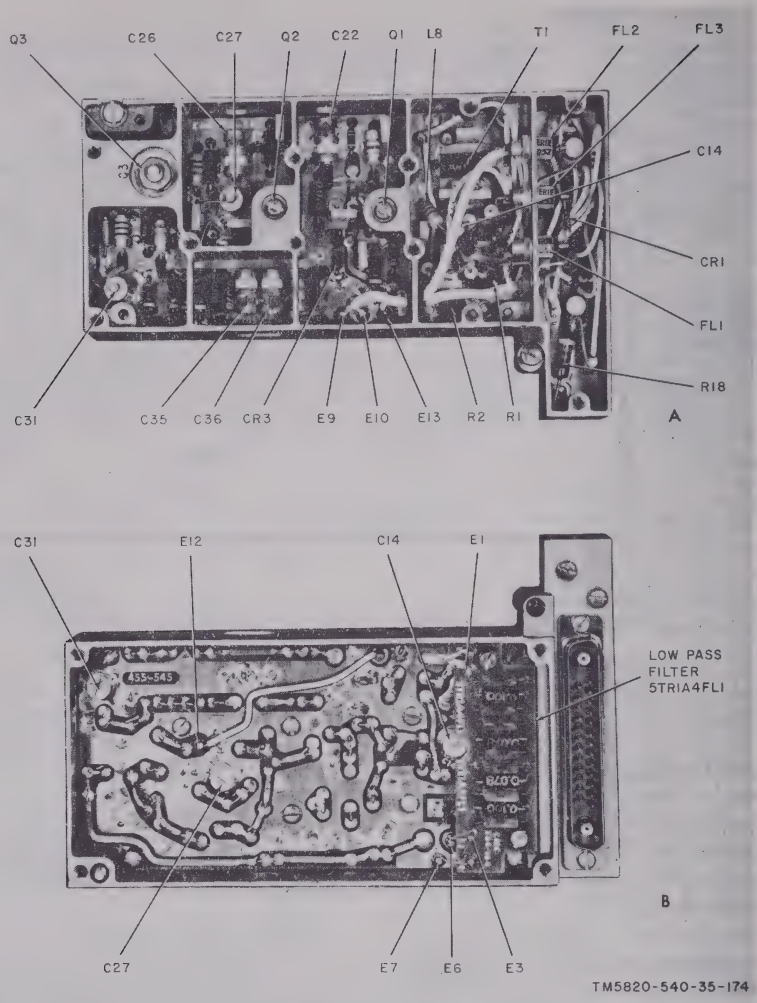


Figure 4-33. Amplifier-frequency multiplier 5TR1A4, parts location.

c. Troubleshooting (fig. 6–1).

Symptom	Checks and corrective measures
No output (*b*(1)(*e*) above).	Check operating voltages of transistor stages on printed circuit board 5TR1A5AR1 (*d* below). Replace defective component as required.
Low output (*b*(1)(*e*) above).	*a.* Measure the signal voltage at E10 (5TR1A5AR1) (fig. 4-37); it should be 98 mv. If level at E10 normal, check operation of attenuator relays K1, K2 and K3.
Normal output; abnormal indications with switch S28 FDM 12 CHAIN or 24 CHAN positions (*b*(3) above).	Replace relay if necessary. *b.* Vary R26; if outp does not change heck continuity of fe back circuit R2(R13 and C4 (5TR1A AR1). *c.* Check C5 (5TR1A AR1) for open circuit replace if necess y. *a.* Measure the voltag and resistances Q1 and Q2 (fig. 4-3 5TR1A5A1 (*d* low). Replace compo nt as required.

Symptom	Checks and corrective measures
	b. Check the forward and reverse resistances of diodes CR1, CR2 and CR3. Replace as required.
tput distorted (*b*(4)(*c*) above).	Using the oscilloscope, observe the output of transistor stages Q1, Q2 and

Symptom	Checks and corrective measures
	Q3 (5TR1A5AR1). Check the voltage and resistances of isolated stage. Replace component as required.
Abnormal output indication with switch S28 set to FDM (*b*(3)(*b*) above).	Check input signal through FL1 (5TR1A5AR1); replace FL1 if necessary.

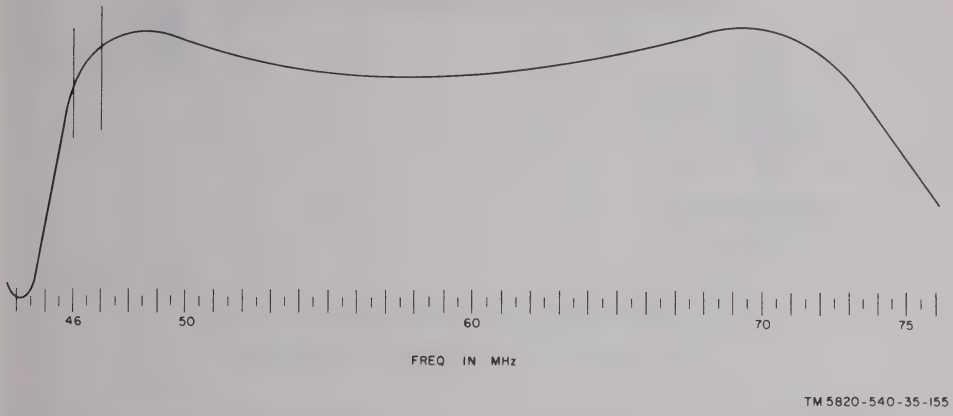


Figure 4-34. Amplifier-frequency multiplier 5TR1A4, frequency response.

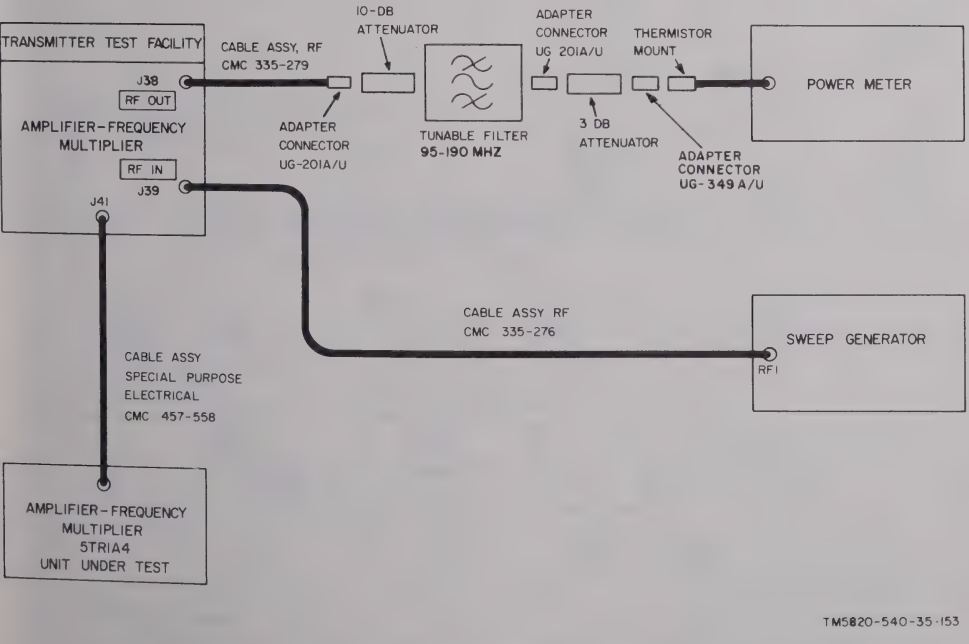


Figure 4-35. Amplifier-frequency multiplier 5TR1A4, harmonic rejection test setup.

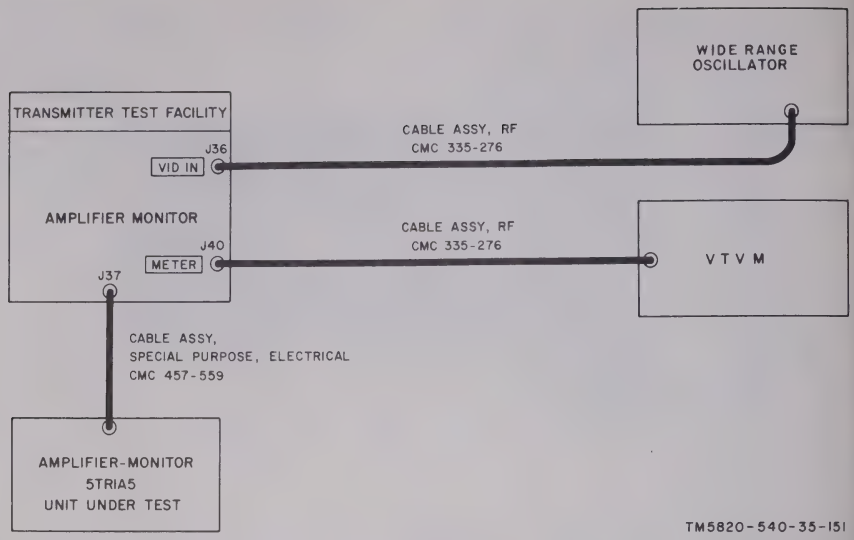


Figure 4-36. Amplifier-monitor 5TR1A5, test setup.

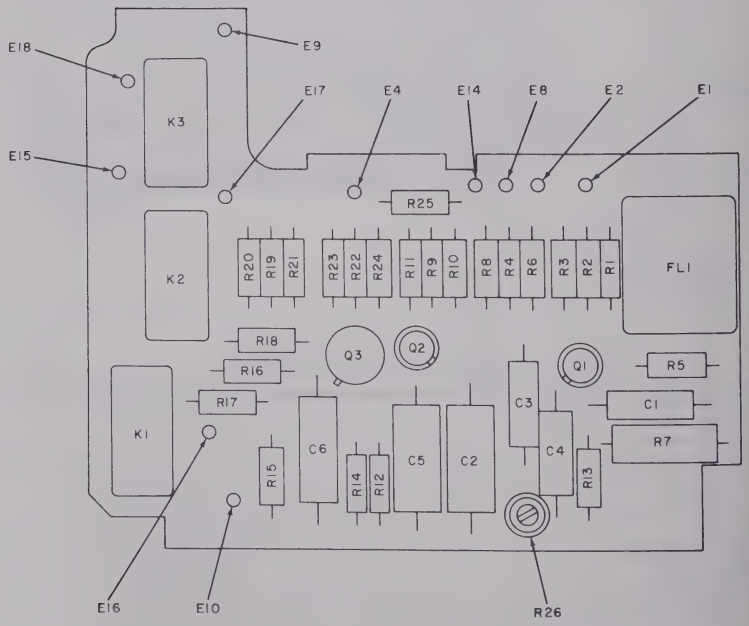
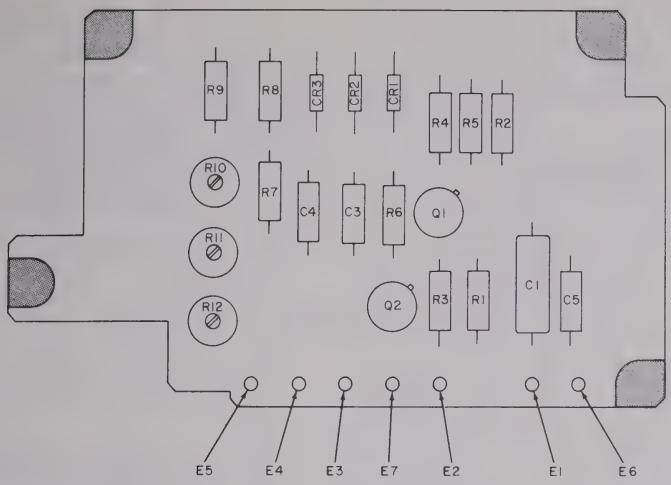


Figure 4-37. Video amplifier 5TR1A5AR1, parts location.



TM5820-540-35-81

Figure 4-38. Video monitor 5TR1A5A1, parts location.

oltage and Resistance Measurements.

NOTE

oltages and resistances measured with the allo-
multimeter.

) *In-circuit voltage measurements.*

Test points	Typical indication (v dc)
Amplifier 5TR1A5AR1:	
Emitter	+1.4
Base	+2.1
Collector	+6.0
Emitter	+1.6
Base	+2.3
-Collector	+6.0
Q3-Emitter	+5.3
-Base	+6.0
-Collector	+12.0
E10 (OW)	0.104
(FDM)	0.098
Video Monitor 5TR1A5A1:	
Q1-Emitter	+1.6
-Base	+2.3
-Collector	+10.0
Q2-Emitter	+9.5
-Base	+10.0
-Collector	+28.0

(2) *Resistance measurements.*

Stage	Transistor		Base (−)				Base (+)			
			Emitter (+)		Collector (+)		Emitter (−)		Collector (−)	
	Ref.	Type	Resistance (ohms)	Range	Resistance (ohms)	Range	Resistance (ohms)	Range	Resistance (ohms)	Range
Video amplifier 5TR1A5AR1	Q1	2N706	3.9k	x 100	7k	x 100	900	x 100	700	x 100
	Q2	2N930	5.1k	x 100	7k	x 100	900	x 100	800	x 100
	Q3	2N697	5.0k	x 100	2.0k	x 100	800	x 100	700	x 100
Video monitor 5TR1A5AR1	Q1	2N697	3.9k	x 100	15k	x 100	700	x 100	700	x 100
	Q2	2N697	15k	x 100	4k	x 100	700	x 100	700	x 100

3. Power Supply 5TR1PS1

ore checking the complete power supply, re-
e and check power supply subassembly 5TR-
1A2 (heat sink) (para 4–24), voltage regu-
r amplifier 5TR1PS1AR1 (para 4–25) and
er supply chassis 5TR1PS1 (para 4–26). Re-
emble the power supply without the heat sink
er and proceed as described below.

. *Test Equipment and Material Required.*

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V).	Accessory kit
Oscilloscope AN/USM-140	Oscilloscope
Multimeter TS-352B/U	Multimeter
Counter, Electronic Digital Readout AN/USM-207.	Counter

. *Test Procedure.*

WARNING

High voltages are present on the unit under test. Always switch test facility switch S2 to OFF when connecting probes.

(1) *Input rectification circuit check.*

(*a*) Connect the test equipment as shown figure 4–39.

(*b*) Place the unit under test in front of air outlet so that the airflow is directed over heat sink.

(*c*) Connect the positive lead of the multi-ter to C1 (+) and the negative lead to C1 (–).

(*d*) Set test facility switches S1 and S2 to eir ON positions.

(*e*) Check the voltage on the power sup- (part of the accessory kit); if necessary ad-t for 115v ac. The multimeter connected to C1 ould indicate 103v ±5v.

(*f*) Set switch S2 to OFF and disconnect multimeter leads from C1.

(2) *Rise time and frequency measurement.*

(*a*) Using the test setup shown in figure 39, locate transformer T2 (fig. 4–40) on the it under test, and connect the oscilloscope obe to pins 1 and 3.

(*b*) Connect the counter to pins 11 and of transformer T2.

(*c*) Press and hold test facility switch S3, en set switch S2 to ON. The counter should dicate 5 kHz ±1 kHz.

(*d*) Set test facility switch S4 to 600V. The rise time (10 percent to 90 percent of peak-to-peak amplitude) measured on the oscilloscope should be less than 2 microseconds. Set switch S2 to OFF.

(*e*) Connect the oscilloscope probe to pins 4 and 6 of transformer T1.

(*f*) Connect the counter to pins 11 and 12 of transformer T1.

(*g*) Set switch S2 to ON. The counter should indicate 400 Hz ±20 Hz. The rise time (10 percent to 90 percent of peak-to-peak amplitude) should be less than 5 microseconds.

(*h*) Set switch S2 to OFF. Disconnect the oscilloscope and the counter.

(3) *Load and voltage regulation check.*

(*a*) Using the test setup shown in figure 4–39, connect the multimeter to connectors J2 and J6 on the test facility and set switch S2 to ON. The multimeter should indicate 12.5v or less.

(*b*) Press switch S5. The indication in (*a*) above should not change by more than 0.25v. Record this new indication.

(*c*) Slowly vary the voltage control on the power supply between 105v ac and 125v ac. The multimeter indication should not change by more than 0.2v.

(*d*) Release switch S5 and reset the voltage control to 115v ac.

(*e*) Connect multimeter to connectors J2 and J12 on the test facility. Press switch S7; note the multimeter indication (27.5v to 29.0v with load.

(*f*) Slowly vary the power supply voltage control between 105v ac and 125v ac. The multimeter indication should not change by more than 0.2v.

(*g*) Release switch S7, reset the voltage control to 115v ac, and disconnect the multimeter.

(4) *Constant current check.*

(*a*) Using the test setup shown in figure 4–39, set test facility switch S4 to DRIVER CUR. Test facility meter M1 should indicate in the green band.

(*b*) Turn the power supply voltage control to 70v ac as indicated on the meter. M1 should still indicate in the green band. Reset the voltage control to 115v ac.

(*c*) Set switch S4 to OUTPUT CUR. Meter M1 should indicate in the green band.

(*d*) Turn the power supply voltage control to 70v ac as indicated on the meter. Meter M1 should indicate more than 10 percent full scale deflection. Reset the voltage control to 115v ac and set switch S2 to OFF.

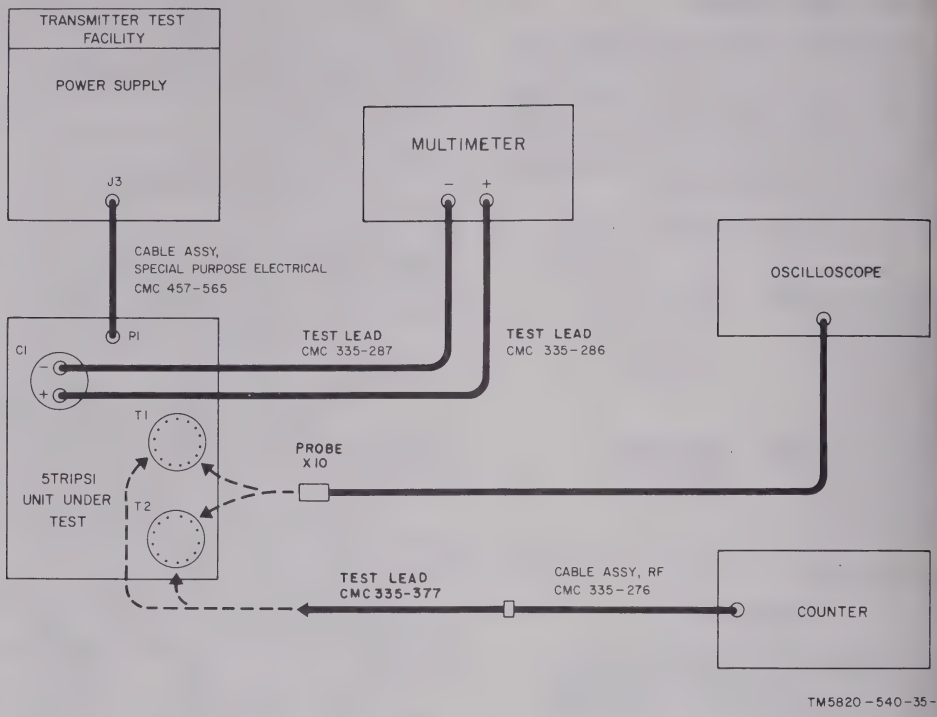


Figure 4-39. Power supply 5TR1PS1, inverter circuits check, test setup.

(5) *High voltage metering circuit calibration.*

(*a*) Remove the small red plastic warning cover from the filter section of the unit under test.

(*b*) Using the test setup shown in figure 4–39, connect the multimeter negative lead to ground and the positive lead to FL24 (fig. 4–40).

(*c*) Set switch S4 to 600V METER position. Press and hold switch S3. Set switch S2 to ON.

(*d*) Adjust the voltage control on the power supply to give an indication of 630v dc ± 1v on the multimeter.

(*e*) On the unit under test adjust R18 control (fig. 4–41) for an indication of 50 percent of full scale on test facility meter M1.

(*f*) Release switch S3 and set switch S2 to OFF. Remove the multimeter connections. Reset the voltage control to 115v ac.

(*g*) Seal R18 as described in paragraph 4–12.

(6) *Shortcircuit protection check.*

(*a*) Using the test setup shown in fig 4–39, set test facility switch S4 to +12V a switch S2 to ON. Note the indication on test cility meter M1. Set switch S2 to OFF.

(*b*) Connect the multimeter (set to 1 DC full scale) to test facility connectors J2 a J6 as shown in figure 4–42.

(*c*) Set switch S2 to ON; the multime should indicate 2.2 amp ±0.4 amp.

(*d*) Set switch S2 to OFF. Remove multimeter leads from connectors J2 and J6.

(*e*) Set switch S2 to ON; meter should indicate the same as in (*a*) above.

(*f*) Set switch S4 to +28V; note the in cation on meter M1.

(*g*) Set switch S2 to OFF. Connect multimeter to connectors J2 and J12 on the t facility.

(*h*) Set switch S2 to ON; the multime should indicate 2.5 amp ±0.5 amp.

(*i*) Set switch S2 to OFF. Remove leads from connectors J2 and J12 on the t facility.

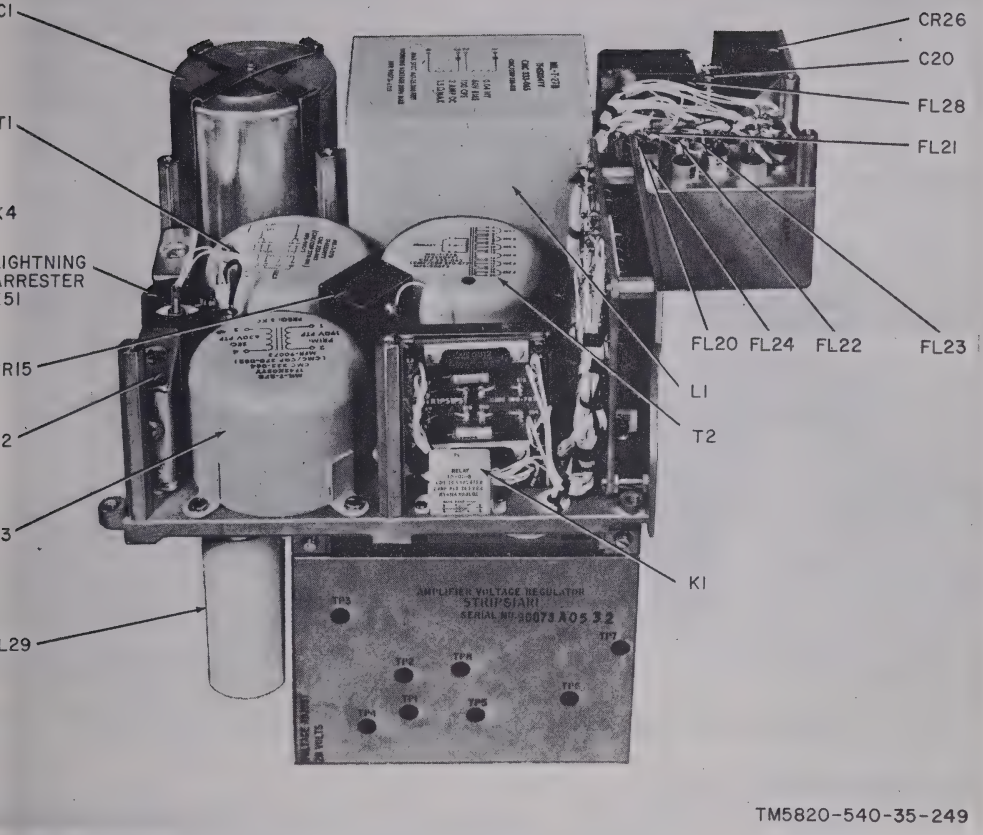


Figure 4-40. Power supply 5TR1PS1, with heat sink removed.

(*j*) Set switch S2 to ON; meter M1 d indicate the same as noted in (*f*) above. witch S2 to OFF.

7) *Hum measurements.* Using the test set- up shown in figure 50A, connect the VTVM to J1 on the transmitter test facility. Set test facility switch S4 to the positions listed below and measure the ripple voltage.

S4 position	Secondary action	Ripple indicated by VTVM
+12V	Press S5 and S7	Less than 3.5 mv
+26V		Less than 350 mv
+28V	Press S5 and S7	Less than 3.5 mv
OUTPUT FIL		Less than 100 mv
DRIVER FIL		Less than 100 mv above OUTPUT FIL indication

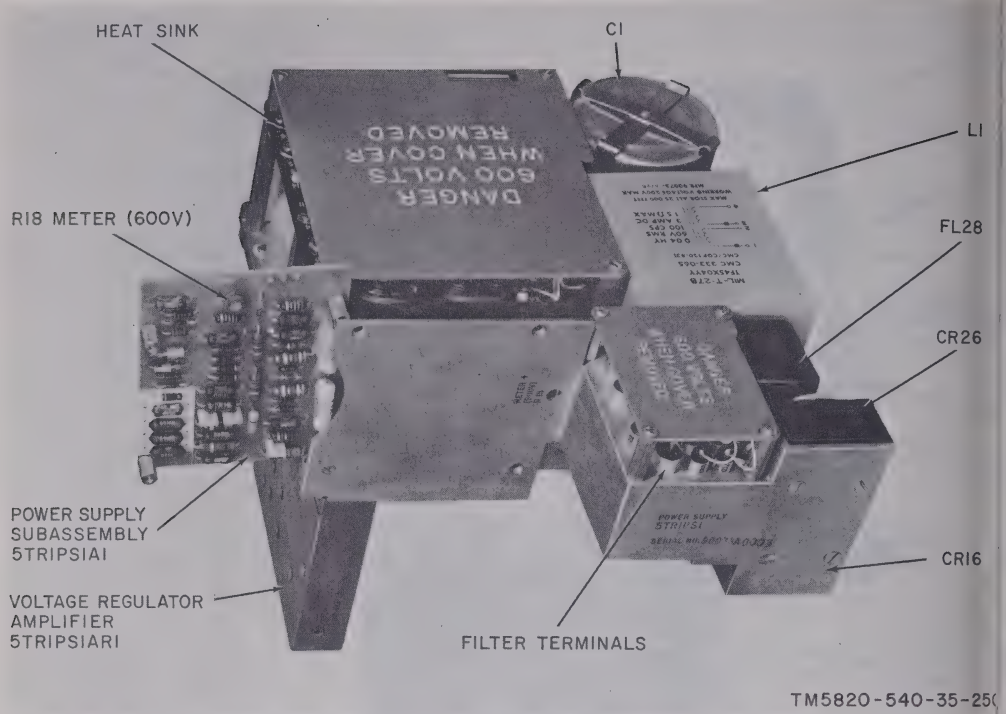


Figure 4-41. Power supply 5TR1PS1 showing access to power supply subassembly 5TR1-PS1A1.

c. Troubleshooting (fig. 6–13).

Symptom	Probable cause	Checks and corrective measures
1. Low voltage across C1, (*b*(1) above).	Defective diodes CR1, CR2, CR3, or CR4 on heat sink (5TR1PS1A2) (fig. 4-43).	Check and replace faulty diode as required.
2. 5-kHz inverter rise time abnormal.	Defective diodes CR5, CR6, CR11 or CR12 on 5TR1PS1A1 (fig. 4-44).	Check and replace faulty diode as required.
3. 400-Hz inverter frequency abnormal.	Circuit characteristic change possible due to a component replacement.	At transformer T1, disconnect the lead from terminal 2 and connec it to terminal 1. Disconnect lead from terminal 4 and connect it t terminal 3. Disconnect lead fror terminal 6 and connect it to terminal 7. Disconnect lead fror terminal 8 and connect it to terminal 9.
4. Abnormal readings of +12v and +28v regulated supplies (*b*(3)(*b*) and (*e*) above).	*a.* Output from heat sink to voltage regulator amplifer 5TR1PS1AR1.	*a.* Readjust the voltage level controls on 5TR1PS1AR1.
	b. Defective CR16 (fig. 4-40)	*b.* Check and replace CR16 if necessary.
5. Abnormal indication in +28v regulation check. (*b*(3)(*f*) above).	*a.* Defective regulator circuit	*a.* Check diodes CR7 and CR8 (fig. 4-45) and components in the Q2 and Q4 stage of 5TR1PS1AR1.
	b. Defective Q5	*b.* Check Q5 on heat sink (para 4-2

Symptom	Probable cause	Checks and corrective measures
Abnormal indication at *b* (3)(*c*) above.		Check Q1, Q3, and Q5 transistors and associated components on 5TR1PS1AR1, (para 4-25).
Abnormal indication DRIVER CUR *b*(4) above.	Defective CR15 or Q13	Check CR15 and Q13 (para 4-26). Replace as required.
Abnormal indication OUTPUT CUR *b*(4) above.	Defective CR14 or Q14	Check CR14 or Q14 (para 4-26). Replace as required.
Abnormal reading in the 600V METER position of S4. Reading at 600V position normal.	*a.* Defective diode CR13 (5TR1PS1AR1).	*a.* Check CR13; replace if necessary.
	b. Open circuit resistor R14 through R18 (5TR1PS1AR1).	*b.* Check resistors; replace as required.
Abnormal indication during +12v shortcircuit protection check.	*a.* Defective diode CR6 (5TR1PS1AR1).	*a.* Check CR6, replace if necessary.
	b. Defective transistor Q1 (5TR1PS1AR1).	*b.* Check and replace Q1, (para 4-25) if necessary.
Abnormal indication during +28v shortcircuit protection check.	*a.* Defective diode CR5 (5TR1PS1AR1).	*a.* Check and replace CR5 if necessary.
	b. Defective transistor Q6 (5TR1PS1A2).	*b.* Check and replace Q6, (para 4-24) if necessary.
Hum measurements out of specified limits.	*a.* +12v: defective C17 (5TR1PS1A2).	*a.* Check and replace C17 if necessary.
	b. +28v: defective C19 (5TR1PS1).	*b.* Check and replace C19 and/or C9 if necessary.
	c. DRIVER HEATER: defective C1 (5TR1PS1PS1).	*c.* Check and replace C1 (fig. 4-46) if necessary.
	d. OUTPUT HEATER: defective C2 (5TR1PS1PS1).	*d.* Check and replace C2 if necessary.

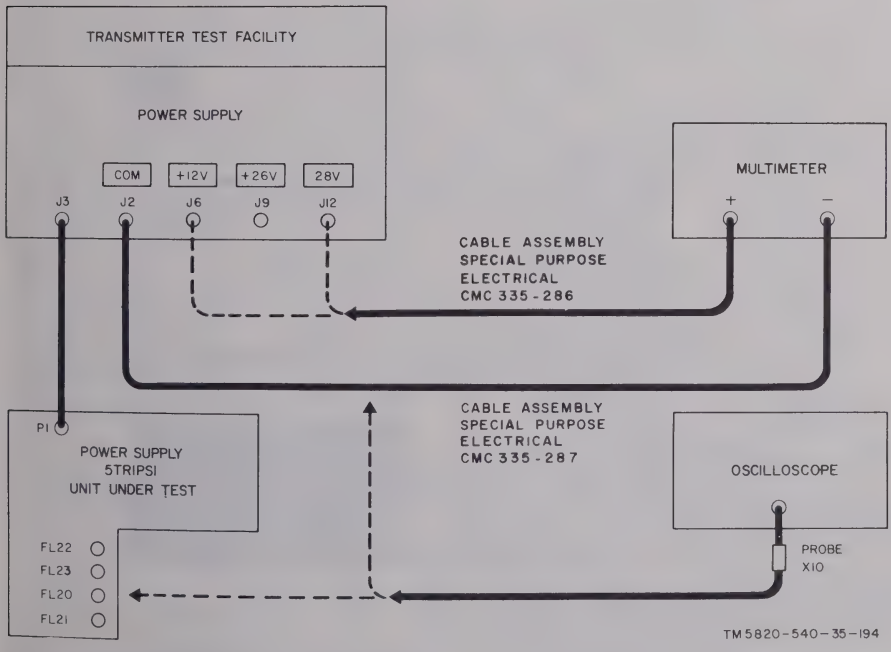


Figure 4-42. Power supply 5TR1PS1, short circuit protection and hum checks, test setup

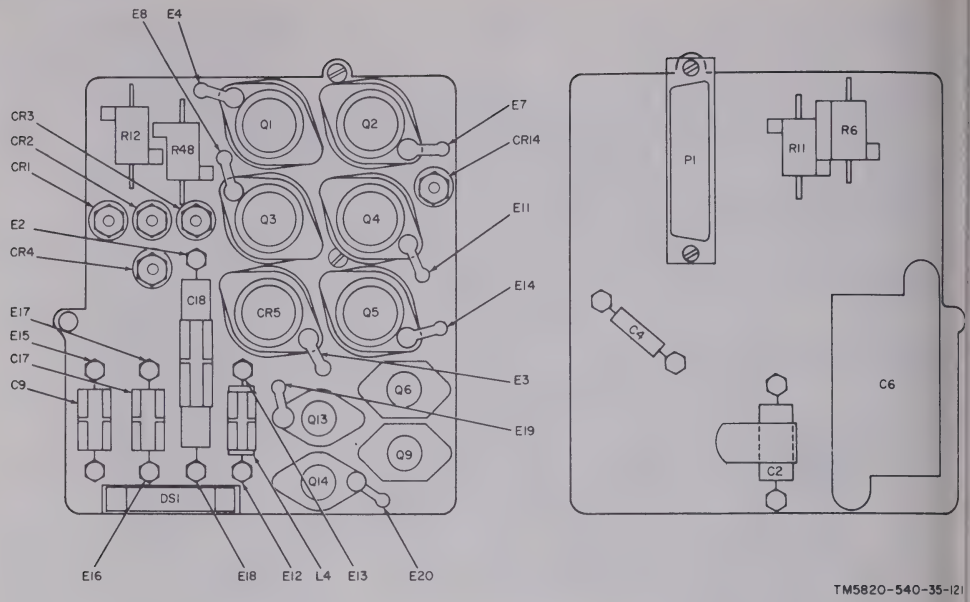


Figure 4-43. Power supply subassembly 5TR1PS1A2, parts location.

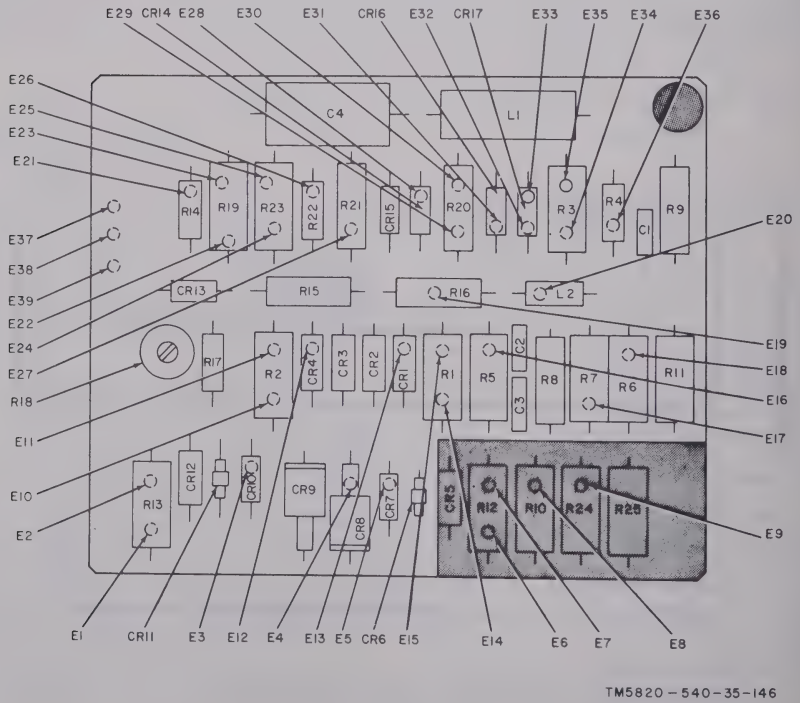


Figure 4-44. Power supply subassembly 5TR1PS1A1, parts location.

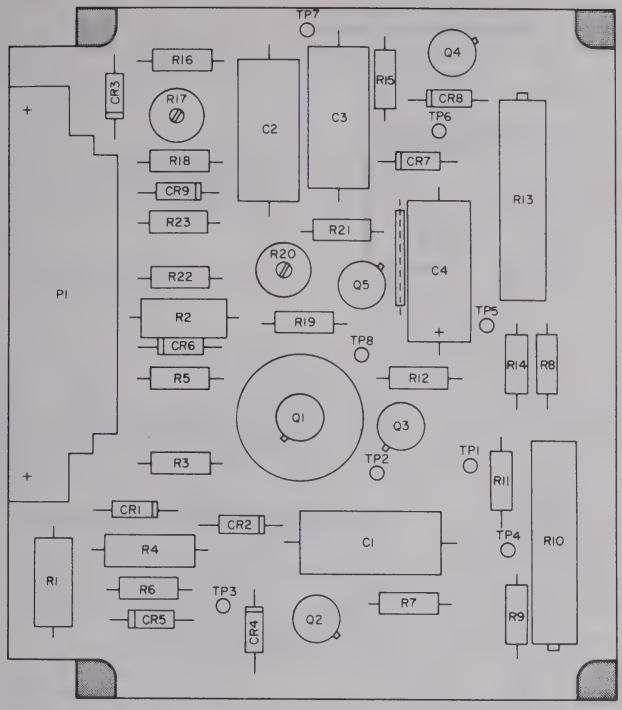


Figure 4-45. Voltage regulator amplifier 5TR1PS1AR1AR1, parts location.

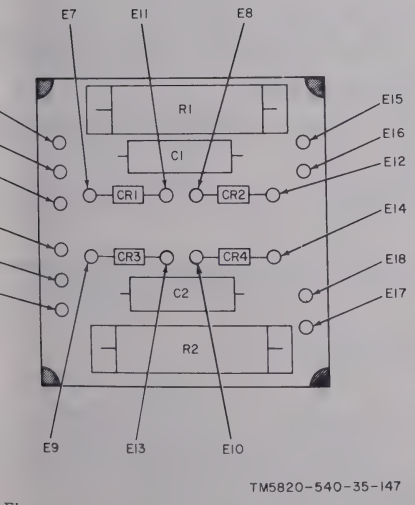


Figure 4-46. Power supply 5TR1PS1PS1, parts location.

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK-2867(V)1/ GRM-95(V).	Accessory kit
Voltmeter, Digital AN/GSM-64	Digital voltmeter
Counter, Electronic, Digital Readout AN/USM-207.	Counter
Multimeter TS-352B/U	Multimeter
Insulation Tester Norma 66701	Insulation tester

. Power Supply Subassembly 5TR1PS1A2

Test Equipment and Material Required.

b. Test Procedure.

(1) Remove the larger red protective cover to expose power supply subassembly (heat sink) 5TR1PS1A2.

(2) Remove 5TR1PS1A2 by loosening the two green-circled mounting screws and pulling the module straight up.

(3) Open the test facility power supply door. Connect 5TR1PS1A2 to the test facility connectors as shown in figure 4-47.

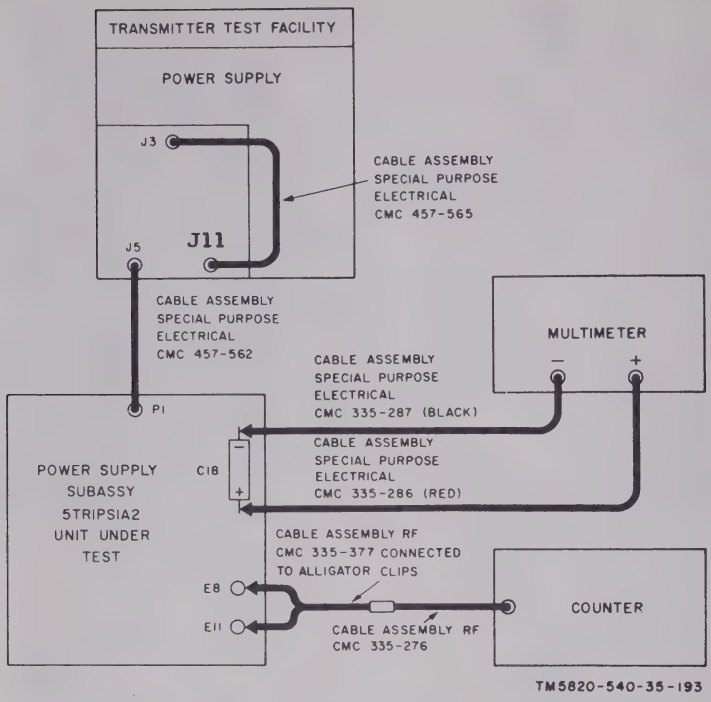


Figure 4-47. Power supply subassembly 5TR1PS1A2, test setup.

NOTE
The ground lead of the counte ust be isolated through a capacit

(4) Remove elapsed time indicator DS1 from the unit under test.

(5) Place the unit under test in front of the air outlet so that the airflow is directed over the heat sink.

WARNING

The outer cases of the transistors mounted on the heat sink are connected to high voltage.

(6) Set the test facility switches as follows:

Switch	Switch Position	Secondary Action	Normal Indications
S1	ON		
S20	S4		
S2	ON		
S4	+12V	Press S5	M1 indicates within the green band f
S4	+12V METER	Press S5	each position of S4.
S4	+28V	Press S7	
S4	+28V METER	Press S7	
S4	+26V		
S4	DRIVER FIL		
S4	OUTPUT FIL		
S4	DRIVER CUR		
S4	OUTPUT CUR		
S4	600V	S2 to OFF Press and hold switch S3 then set switch S2 to ON.	
S4	600V METER	S2 to OFF Press and hold switch S3 then set switch S2 to ON.	
S4	26V AC		

NOTE

hroughout the following tests, observe and maintain e input voltage at 115v ac shown on the power sup- y voltmeter (part of the accessory kit).

(7) (*a*) Set S4 to +26V.

(*b*) Operate S2 to ON and OFF three es fairly quickly. M1 should indicate within green band each time S2 is switched to ON. s checks the starting circuit.

(*c*) Set S2 to OFF.

(8) (*a*) Connect the digital voltmeter across acitor C18 (observe polarity), as shown in re 4–47.

(*b*) Set S2 to ON. The digital voltmeter should indicate 100v ±5v. This checks the input rectification circuit.

(*c*) Set S2 to OFF.

(9) (*a*) Connect the counter across terminals E8 and E11 on the unit under test. Set S2 to ON. The counter should indicate 5 kHz ± 1 kHz. This checks the 5 kHz inverter.

(*b*) Set S2 to OFF. Disconnect the counter.

(10) Set S1 to OFF.

NOTE
The ground lead of the counter must be isolated through a capacitor.

c. Troubleshooting (fig. 6–13).

Symptom	Probable cause	Checks and corrective measures
o indications with switch S4 in position +12V through 600V METER. Normal indication in 26V AC in position.	*a.* CR14 shorting	*a.* Check CR14 (fig. 4-43) for short circuit. Replace if necessary.
	b. Defective transistor Q3, Q4, Q5, Q6, Q9, Q13, or Q14.	*b.* Measure the resistance of transistors, see *d* below. Replace as required.
	c. C4, C9 or C17 shorting	*c.* Check capacitors; replace as required. Observe the polarity when connecting the multimeter.
	d. R11 or R12 open circuit or shorting to ground through heat sink.	*d.* Check resistors for open circuit. Using insulation tester, check for short circuit to heat sink (fig. 4-43 and 4-48).
onormal indication with switch S4 in DRIVER CUR position. All other indications are normal.	Defective Q13	Measure resistance of Q13 (*d* below). Replace Q13, if necessary.
onormal indication with switch S4 in OUTPUT CUR position. All other indications are normal.	Defective Q14	Measure resistance of Q14 (*d* below). Replace Q14, if necessary.
bnormal indication with switch S4 in position 26V AC. All other indications are normal.	Defective 400 Hz inverter	Measure resistance of Q1 and Q2 (*d* below). Check C2 for short circuit and R6 for open circuit (fig. 4-48). Replace components as required.
est facility switch S1 trips and will not reset.	Short circuited component associated with input circuit of power supply.	Check diodes CR1 through CR5 and CR14 for shorts. Check C18 for shortcircuit. Replace components as required.
est facility switch S1 stays on. No reading in any of the switch S4 positions.	*a.* Resistor R48 open circuit	*a.* Check R48 (4.99 ohms). Replace if necessary.
	b. Starting circuit not operating.	*b.* Check C18 for open circuit. Using insulation tester check for shortcircuit through mounting clip to heat sink.
00v test trips 5 kHz inverter	C6 shorting	Check and replace.

Resistance Measurements (fig. 4–43).

NOTE

All resistances measured with allocated multimeter.

ge and nsistor type	Base (–)				Base (+)			
	Emitter (+)		Collector (+)		Emitter (–)		Collector (+)	
	Resistance (ohms)	Range	Resistance (ohms)	Range	Resistance (ohms)	Range	Resistance (ohms)	Range
DTS423	2,000 k	x 10,000	Infinity	x 10,000	600	x 100	560	x 100

Stage and transistor type	Base (−)				Base (+)			
	Emitter (+)		Collector (+)		Emitter (−)		Collector (+)	
	Resistance (ohms)	Range	Resistance (ohms)	Range	Resistance (ohms)	Range	Resistance (ohms)	nge
Q2 DTS423	300 k	x 10,000	Infinity	x 10,000	600	x 100	560	x 00
Q3 DTS423	500 k	x 10,000	Infinity	x 10,000	600	x 100	560	x 00
Q4 DTS423	5,000 k	x 10,000	Infinity	x 10,000	600	x 100	560	x 00
Q5 2N1490	Infinity	x 10,000	Infinity	x 10,000	610	x 100	600	x 00
Q6 2N1485	Infinity	x 10,000	Infinity	x 10,000	600	x 100	580	x 00
Q9 2N1485	Infinity	x 10,000	Infinity	x 10,000	560	x 100	540	x 00
Q13 2N3441	Infinity	x 10,000	Infinity	x 10,000	550	x 100	540	x 00
Q14 2N3441	Infinity	x 10,000	Infinity	x 10,000	570	x 100	560	x 00

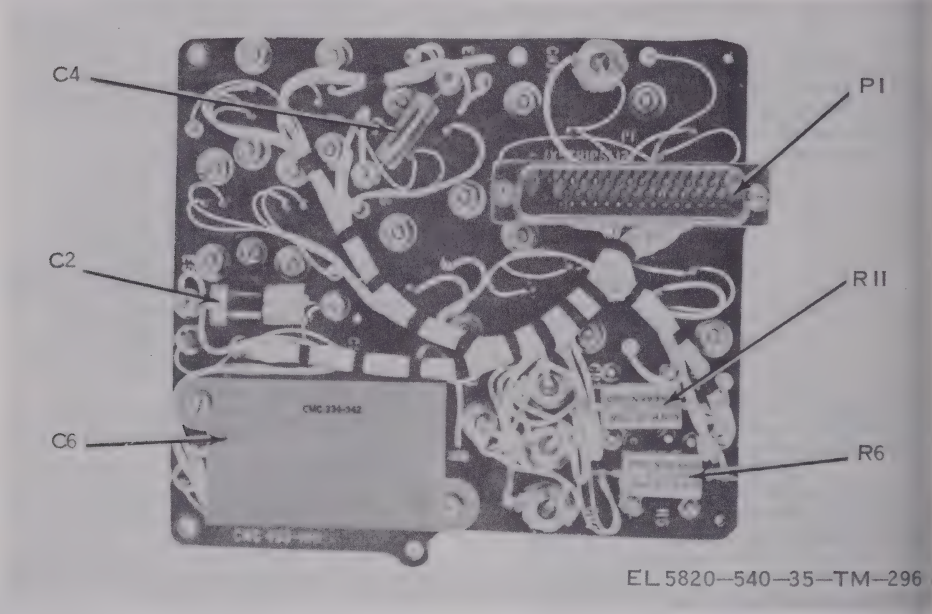


Figure 4-48. Power supply subassembly 5TR1PS1A2, rear view.

4-25. Voltage Regulator Amplifier 5TR1PS1AR1

a. Test Equipment and Material Required.

Test Facility Transmitter TS-2866(V)1/GRM-95 (V) ---------- Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V) 1/GRM-95(V) ---------- Accessory kit
Voltmeter Electronic ME-30A/U ---------- VTVM
Multimeter TS-352B/U ---- Multimeter

b. Test Procedure.

(1) Remove both covers from the unit under test.

(2) Open the test facility power supply door and remove the jumpers between J4 and J5, J7 and J8, J10, and J11 connectors.

(3) Connect the test equipment as shown in figure 4-49.

(4) Place the unit under test in front of the air outlet so that airflow is directed over the heat sink.

(5) Set the test facility switches as follows:

Switch	Position
S1	ON
S20	S4
S4	+28V
S2	ON

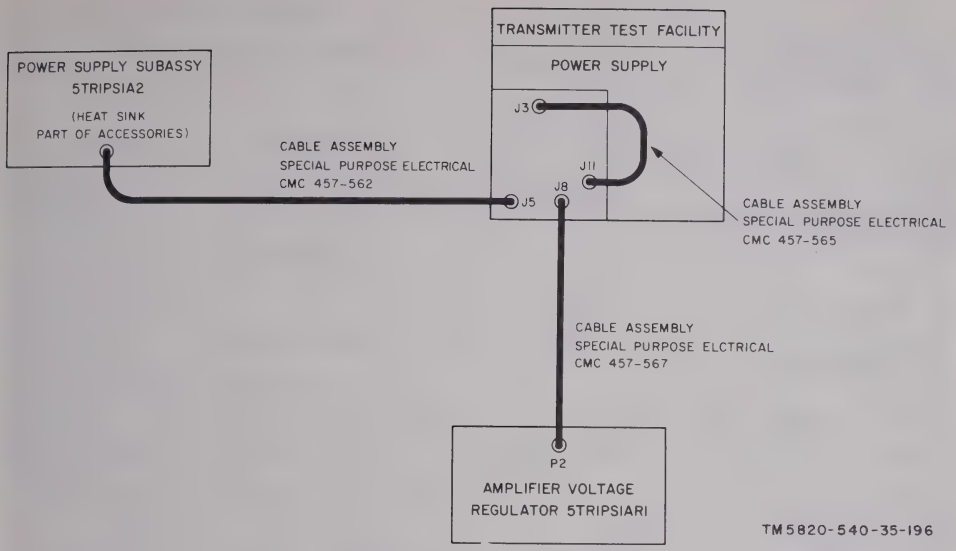


Figure 4-49. Voltage regulator amplifier 5TR1PS1AR1, test setup.

(6) Adjust the voltage control on the power ply (part of the accessory kit) to 115v ac as icated on the power supply voltmeter.

(7) Press and hold S7. Meter M1 should icate between 30% and 70%.

(8) Adjust R10 (fig. 4–45) for a 50 per- t of full scale indication on meter M1.

(9) Release S7; meter M1 indication should etween 40% and 80%.

(10) Set switch S4 to the +28V METER posi- n. Press and hold S7. Meter M1 should indi- e in the green band.

(11) Adjust R17 (fig. 4–45) for a 50 per- t of full scale indication on meter M1.

(12) Set switch S4 to the +12V position. ss test facility switch S5. The meter M1 uld indicate between 30% and 70%.

(13) Hold S5 depressed and adjust R13 (fig. 5) for a 50 percent of full scale indication on ter M1.

(14) Release S5; meter M1 indication should between 40% and 80%.

(15) Set switch S4 to the +12V METER po- on. Press and hold S5; meter M1 should indi- e within the green band.

(16) Adjust R20 (fig. 4–45) for a 50 percent full scale indication on meter M1.

(17) Release S5; meter M1 indication should ain within the green band.

(18) Set switch S4 to the +12V position. Press and hold S5. Observe meter M1 indication.

(19) Adjust the voltage control on the power supply to reduce the input voltage to 105v ac. Meter M1 indication should remain the same as in (18) above.

(20) Seal R10, R17, R13, and R20 as described in paragraph 4–12.

(21) Set test facility switches S1 and S2 to OFF.

c. Troubleshooting (fig. 6–13). If there is no meter indication in the +12V and/or +28V positions, isolate the defective component or components by making resistance measurements.

NOTE

Use the allocated multimeter for all resistance measurements.

(1) Check all diodes first. Use the Rx10K range to check the 1N821 diodes. They should measure approximately 300 kohm in the reverse direction and approximately 10k ohm in the forward direction.

(2) Check the in-circuit resistance of the transistors (fig. 4–45) as indicated in the chart below.

(3) Repeat the test procedure in *b* above after repairing a fault.

Stage and transistor type	Base (−)				Base (+)			
	Emitter (+)		Collector (+)		Emitter (−)		Collector (+)	
	Resistance (ohms)	Range	Resistance (ohms)	Range	Resistance (ohms)	Range	Resistance (ohms)	Range
Q1 2N697	15 k	x 10,000	....	x 10,000	800	x 100	740	x 100
Q2 2N697	3,500	x 100	75 k	x 10,000	780	x 100	740	x 100
Q3 2N697	1,800	x 100	15 k	x 10,000	760	x 100	700	x 100
Q4 2N697	8,500	x 100	1,200	x 100	780	x 100	700	x 100
Q5 2N697	300 k	x 10,000	300 k	x 10,000	780	x 100	700	x 100

26. Power Supply (Chassis) 5TR1PS1

Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V).	Accessory kit
Insulation Tester, Norma 66701.	Insulation tester
Multimeter TS-352B/U	Multimeter
Oscilloscope AN/USM-140.	Oscilloscope
Voltmeter, Electronic ME-30A/U.	VTVM

b. Test Procedure.

(1) Open the test facility power supply hinged cover and remove the jumper cables.

(2) Connect the test equipment as shown in figure 4–50A.

(3) Place the unit under test in front of the air outlet so that the airflow is directed over the heat sink.

(4) Set the test facility switches as follows:

Switch	Position
S1	ON
S20	S4
S4	+12V
S2	ON

(5) Set test facility switch S4 to all positions; monitor the indications on meter M1 as follows:

Switch S4 in position	Secondary action	Meter M1 reads	Maximum ripple indicated on VTVM
+12V	Press S5 and S7	In green band	3.5 mv
+12V METER		In green band	
+28V	Press S5 and S7	In green band	3.5 mv
+28V METER		In green band	
+26V		In green band	350 mv
OUTPUT FIL		30% to 70% full scale.	120 mv
DRIVER FIL		30% to 70% full scale.	120 mv above OUTPUT FIL reading.
DRIVER CUR		30% to 70% full scale.	
OUTPUT CUR		30% to 70% full scale.	
600V	Set switch S2 to OFF. Press and hold switch S3 to ON then switch S2 to ON.	30% to 70% full scale.	10 mv
600V METER	Set switch S2 to OFF. Press and hold S3 to ON then switch S2 to ON.	30% to 70% full scale.	
26V AC		In green band.	

(6) Connect the test equipment as shown in ure 4–50B.

(7) Set test facility switch S4 to 600V TER position.

(8) Press and hold switch S3, set switch to ON and adjust the voltage control on the ver supply (to increase the input voltage) unthe multimeter indicates +630v ±1v. Meter M1 should indicate 50 percent of full scale deflection.

(9) If necessary adjust R18 on the unit under test for a 50 percent indication on M1 meter.

(10) Release switch S3 and set switch S2 to OFF.

(11) Return the voltage control on the power supply to 115v ac.

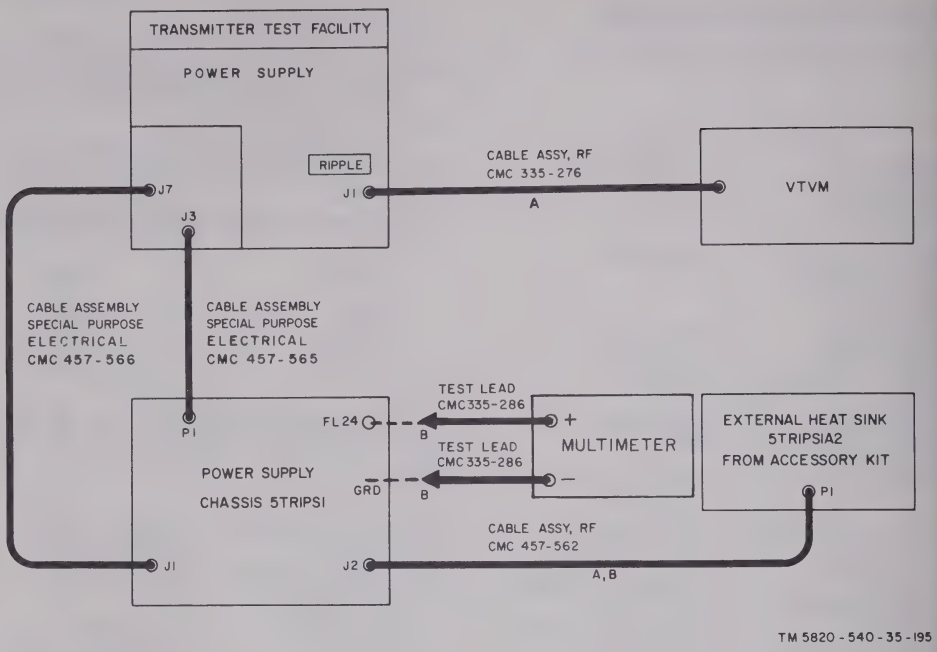


Figure 4-50. Power supply (chassis) 5TR1PS1, test setup.

c. *Troubleshooting* (fig. 2–50).

Symptom	Probable cause	Checks and corrective measures
1. Test facility switch S1 trips and will not reset.	Short circuit on the input side of circuit due to a component failure or conductor shorting to ground.	*a.* Check lightning arrestor E51 (fig. 4-40) for short circuit. *b.* Check C1 for short circuit. Observe polarity when connecting the multimeter. Multimeter should indicate 20k ohm minimum. *c.* Using the insulation tester, check T2, T1, and associated components. Disconnect the heat sink; connect the positive lead of the insulation tester to L1 pins 1 and 4 in turn; depress both 500V and SKALA III buttons; the insulation tester meter should indicate 100 megohms minimum. Isolate T1 by disconnecting leads at T1 pins 5 and 16. Replace components as required.
2. Test facility switch S1 remains on. No. S4 meter indication.	Starting circuit not operating	. .Check starting pulses across R6 and R9 (fig. 4-44) on 5TRiPS1A1. Use an oscilloscope to observe a 100-volt pulse, 10 to 30 milliseconds long, immediately after test facility switch S2 is turned on. If these pulses

Symptom	Probable cause	Checks and corrective measures
		are not present, check the operation of relay K1 and associated circuits.
o meter indication in the 600V position.	*a.* Relay K2 not operating	*a.* Check operation of relay K2; replace if necessary.
	b. Open circuit	*b.* Check components in the 600v circuit for open circuit.
o meter indication in 600V position. +12V and +28V ripped on 600V test.	*a.* CR15 defective	*a.* Check CR15 for short circuit, replace if necessary.
	b. T3 shorting to ground	*b.* Check T3 and replace if necessary.
st facility meter reads 30% or less in 600V position.	R48 not bypassed	Check operation of relay K4 and replace if necessary.
V AC normal, all other S4 ndications abnormal.	*a.* Defective component in secondary of T2.	*a.* Disconnect all secondary circuits in turn; switch S2 to ON after each disconnection; check for 600v. If trouble is isolated to a secondary circuit, locate the defective component by making resistance measurements of the chassis components.
	b. 5-kHz inverter circuit defective	*b.* If problem present, with all secondary circuits of T2 disconnected, check 5 kHz circuit components not mounted on the heat sink.
Low indication with switch S4 in DRIVER FIL position.	Defective CR1, CR2, C1, or FL29	Check diodes CR1 and CR2 (fig. 4-46) on 5TR1PS1PS1 printed circuit board. Check C1 and FL29 for short circuit; observe polarity of C1 and FL29. Check FL29 pin 2(+) and pin 6(−) for short circuit.
Low indication with switch S4 in OUTPUT FIL position.	Defective CR3, CR4, C2, or FL29	Check diodes CR3 and CR4 on 5TR1PS1PS1 circuit board. Check C2 and FL29 pin 5 (+) to pin 4 (−) for short circuit. Replace as required.
Abnormal reading with switch S4 in DRIVER CUR position. Normal reading at DRIVER FIL position.	Defective CR15, R21 or R23	Check CR15, R21 and/or R23. Replace as required.
Abnormal reading with switch S4 in OUTPUT CUR position. Normal reading at OUTPUT FIL position.	Defective CR14, R19 or R20	Check CR14, R19 and/or R20. Replace as required.
+12v and +28v ripple measurement high.	Leaky or open filter capacitor C19	Check and replace C19 if necessary.
+26v ripple measurement high	Leaky or open filter capacitor C20 or C4.	Check capacitor. Replace as required.
Driver heater and/or output heater ripple measurements high.	Leaky or open filter capacitor C1, C21 or FL29.	Check the components associated with faulty circuit. Replace as required.
600v ripple measurement high.	Defective C6	Check and replace C6 if necessary.

27. Transmitter Case 5A2

NOTE

he following procedure checks the continuity or round connections of the interconnecting cable beveen the transmitter fixed head and the transmitter head.

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facility Set MK-1173(V)1/ GRM-95(V).	Accessory kit

b. Test Procedure—Continuity Check.

(1) Connect the test equipment as shown in figure 4–51.

(2) Set test facility switches S1 and S6 to their ON positions.

(3) On the interconnecting box set switch S1 to positions 1 through 43 as shown in the chart below.

Interconnecting box switch S1	S2	Lamp lights with S2 in positions
1	1 through 47	1, 44 through 47
2	1 through 47	2, 44 through 47
3	1 through 47	3, 44 through 47
4	1 through 47	4, 44 through 47
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
43	1 through 47	43, 44 through 47

(4) Set interconnecting box switch S2 to position 44 through 47. The indicator lamp should light, independent of the switch S1 position.

4–28. Distribution Box 5A2A1

Refer to paragraph 4–27 for continuity checks on distribution box 5A2A1. Refer to paragraph 4–84 for replacement procedures.

4–29. Amplifier-Frequency Multiplier AM–4320/GRC–103(V)

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V).	Transmitter test facility.
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V).	Accessory kit
Wattmeter AN/URM-120	Wattmeter
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) *Preliminary power output adjustmen*

(*a*) Remove the dust cover from the un to be tested. Connect the test equipment as shov in figure 4–52A.

(*b*) Connect the flexible cooling air exte sion pipe to the test facility and place the nozz on its stand behind the unit under test.

(*c*) Set the XMTR TUNE and XMT CHANNEL controls on the unit under test to i dicate channel 340.

(*d*) Set the test facility switches as fo lows:

Switch	Switch position	Normal indication
S1	ON	
S20	S12	
S12	OSC	Test facility meter M1 reads between 20% and 90% fu scale deflection. LOW PWR lamp on the test facility should light.

(*e*) Check the 115v ac on the power su ply (part of the accessory kit); adjust if require

(*f*) Set the test facility switches follows:

Switch	Switch position	Normal indication
S12	DBLR	M1 indicates between 25% and 90% of full scale.
S12	MULT	M1 indicates between 20% and 90% of full scale.

(*g*) Set switch S13 to ON. Recheck f 115v ac on the power supply; readjust if require

(*h*) Set test facility switch S12 to t DRIVER position. Push in the unit under te PWR OUT PEAK knob and tune for maximu

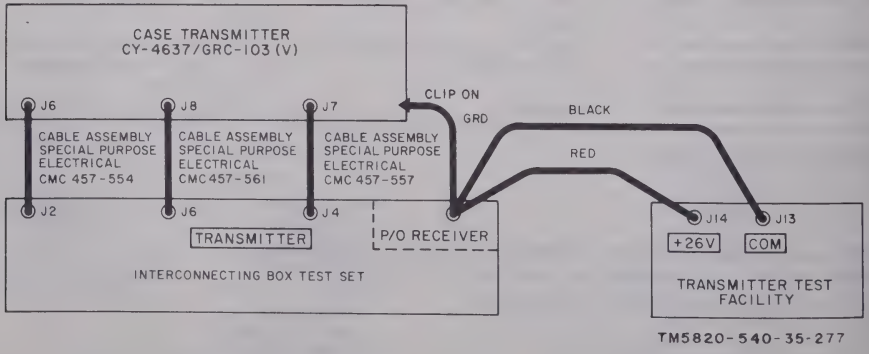


Figure 4-51. Transmitter case, continuity check, test setup.

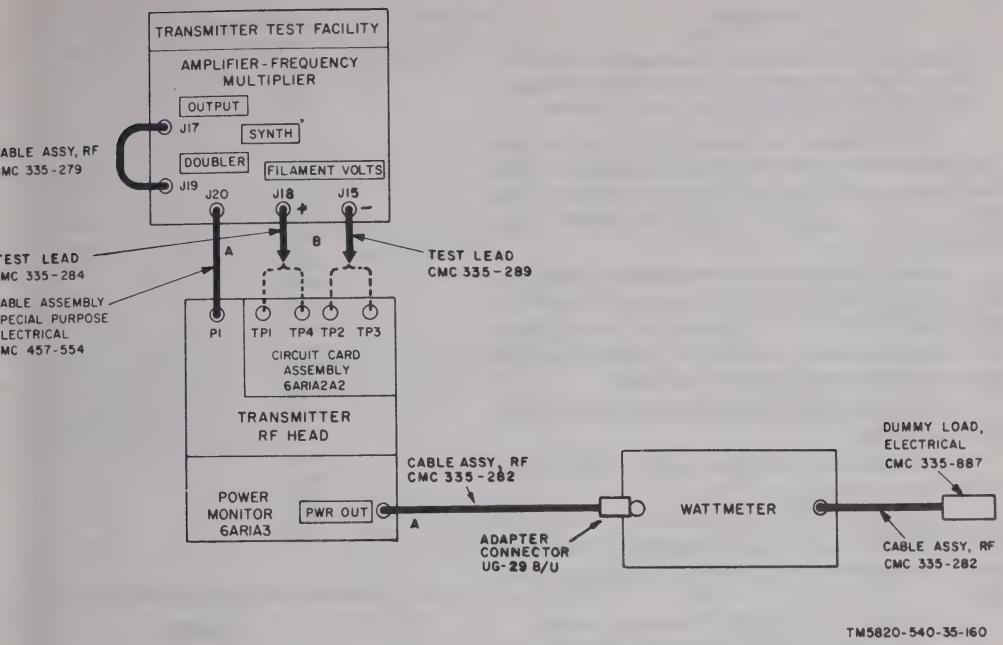


Figure 4-52. Amplifier-frequency multiplier AM-4320/GRC-103(V), test setup.

ication on meter M1. Meter M1 should indie between 25 percent and 90 percent of full le.

(*i*) Set test facility switch S12 to the PWR T position. Pull out the PWR OUT PEAK trol and tune for maximum indication on ter M1. Meter M1 should indicate between 25 cent and 90 percent of full scale. The t facility LOW PWR lamp should go out.

(*j*) Set test facility switch S12 to REFL T. Meter M1 should indicate less than 20 rcent of full scale.

(2) *Cathode and heater voltage adjustments l tube emission check.*

(*a*) On the unit under test connect test nts TP3 and TP4 of circuit card assembly R1A2A2 (fig. 3–13) connectors to test facili- J15 and J18 (FILAMENT VOLTS) respective- as shown in figure 4–52B.

(*b*) Set test facility switch S12 to position F. Note the indication on meter M1.

(*c*) Set switch S12 to position FIL V. just R3 FIL on 6AR1 until meter M1 indicates same as noted in (*b*) above.

(*d*) Connect circuit card assembly R1A2A2 test points TP1 and TP2 to the test ility connectors J18 and J15 (FILAMENT LTS) (fig. 4–52B).

(*e*) Reset switch S12 to REF. Note the indication on meter M1.

(*f*) Set switch S12 to FIL V. Adjust R4 FIL on 6AR1 until meter M1 indicates the same as noted in (*e*) above. Allow a 60-second warm-up period before continuing.

(*g*) Set switch S12 to DRIVER CUR. Adjust R1 BIAS DRIVER on 6AR1 for a 50 percent of full scale indication on meter M1.

(*h*) Set switch S12 to OUTPUT CUR. Adjust R2 BIAS OUTPUT on 6AR1 for a 30 percent of full scale indication on meter M1.

(*i*) Set switch S12 to EMISSION and switch S15 to OUTPUT.

(*j*) Press test facility EMISSION switch S14 for 15 seconds and observe meter M1. Meter M1 should indicate within the green band and remain constant for the duration of the test.

NOTE

If the meter M1 indication slowly reduces below the green band, replace the output tube and repeat (*d*) through (*f*) and (*h*) through (*j*) above.

(*k*) Set switch S15 to DRIVER. Press EMISSION switch S14 for 15 seconds and observe meter M1. Meter M1 should indicate within the green band and remain constant for the duration of the test.

NOTE

If meter M1 indication slowly reduces by more than 10% of full scale deflection, replace the driver tube and repeat (*a*) through (*c*), (*g*), and (*k*) above.

(*l*) Repeat (1)(*h*) and (1)(*i*) of the preliminary power output adjustment above. The level measured by the wattmeter connected to the PWR OUT connector should be greater than 30 watts.

(*m*) Disconnect the wattmeter from the PWR OUT connector. Set switch S12 to the PWR OUT and REFL OUT positions in turn. Meter M1 should indicate between 20 percent and 90 percent of full scale in both positions.

(*n*) Reconnect the wattmeter to the PWR OUT connector.

(*o*) Set test facility switch S12 to the PWR OUT position.

(*p*) On the unit under test rotate the XMTR TUNE control until meter M1 indicates zero. The test facility LOW POWER lamp should light.

(3) *Power output and tracking check.*

(*a*) Using the test setup shown in figure 4–52A, set the XMTR TUNE and XMTR CHANNEL controls on the unit under test to indicate channel 40.

(*b*) Set test facility switch S12 to the DRIVER position. On the unit under test push in the PWR OUT PEAK knob and tune for maximum meter indication on meter M1.

(*c*) Set switch S12 to PWR OUT. Pull out the PWR OUT PEAK control and tune for maximum indication on meter M1. The level measured by the wattmeter should be greater than 35 watts.

(*d*) Repeat (*a*) through (*c*) above for remaining channels indicated in the chart below.

Channel	Minimum power (watts)
60	.35
80	.35
100	.32
111	.30
112	.30
120	.30
140	.30
160	.30
179	.30
180	.30
200	.30
220	.30
230	.30
240	.30
260	.30
280	.30
300	.30
320	.30
340	.30
360	.30
380	.30
400	.30
409	.30

(*e*) Set switch S13 to OFF.

NOTE

If the specified power output level cannot be met, t position of the XMTR TUNE control may be vari and the PWR OUT PEAK control repeaked. Variati of the XMTR TUNE control should not displace t selected CHANNEL number more than 1/2 in above or below the display window center line.

If the specified power output level cannot be m after repeaking, as in (*l*) above, remove frequen multiplier 6A2 (para 3–53) and rotate the hexagon shaft by *one flat* cw (60° rotation). Replace 6A2 a repeat (*a*) through (*d*) above.

If the specified power output level cannot be m after repeaking and rotating the 6A2 shaft, as abo remove frequency multiplier 6A2 (para 3–53) a rotate the hexagonal shaft by two flats ccw (12 rotation). Replace 6A2 and repeat (*a*) through (above.

c. Troubleshooting (fig. 6–14).

Sympton	Probable cause	Checks and corrective measures
1. DRIVER metering greater than 100 percent full scale.	Faulty rf power level control 6A5 or loss of control voltage to 6A5 (fig. 3-6).	Measure voltage at 6A5FL1; it should be between 7.2 and 9.5v dc. If low or high, remove 6A5 and troubleshoot (para 3-16). If zero volt at 6A5FL1, check 6A5P2, 6W2J1, and wiring to 6AR1A2A2, (refer to fig. 6-14).
2. LOW POWER lamp does not go out within 60 seconds after test facility switch S13 is set to ON. Low level at PWR OUT connector, and low meter indication with test facility switch S12 at PWR OUT. (*b*(1)(*h*) and (*i*) above).	*a.* Defective power monitor 6AR1A3 (high insertion loss) (fig 3-13).	*a.* Measure the power at P2 (6AR1A3J1). Use test set-up shown in figure 4-52B. If level is normal replace 6AR1A3.

Symptom	Probable cause	Checks and corrective measures
	b. Defective low pass filter 6AR1A2FL1 (fig. 3-13).	*b.* Measure the power at 6AR1A1J2. If normal, check continuity of 6AR1A2FL1 connectors P1 and P2. If open or shorting, repair connectors. If connectors. If connectors are normal, replace 6AR1A2FL1.
	c. Defective amplifier sub-assembly 6AR1A1.	*c.* Measure the power at 6AR1A2-A4J2. If a normal reading (not less than 4 watts) is obtained, check the output amplifier stage as shown in paragraph 4-34.
W POWER lamp does not go out ithin 60 seconds after S13 set to ON. Low meter in-cation with S12 at PWR OUT. evel at PWR OUT connector ormal.	*a.* Defective power monitor 6AR1A3 (fig 3-13).	*a.* Disconnect P1 from 6W1J3 and measure the PWR OUT meter current across pins 1 and 2 of P1 (fig. 4-53A). Multimeter should read between 80 μa and 89 μa. If abnormal replace 6AR1A3.
	b. Defective wiring 6W1J3 to connector filter assembly 6AR1A2A3. (fig. 3-6).	*b.* Check continuity of wires from 6W1J3 to 6AR1A2A3 pins 26 and 27. Repair or replace FL26 or FL27 as required.
REFL OUT reading (*b*(1)(*j*) bove).	Defective power monitor 6AR1A3 (fig. 3-13).	Measure the REFL OUT meter current across pins 2 and 3 of P1 (fig. 4-53B). Multimeter should read between 28.5 μa and 31.5 μa. If abnormal replace 6AR1A3.
W POWER lamp does not go out ithin 60 seconds after S13 set to ON. Low meter in-cation with S12 at positions WR OUT and DRIVER.	*a.* Defective output amplifier stage of 6AR1A1.	*a.* Measure the power at 6AR1A2-A4J2. If normal set S13 to OFF and disconnect the transmitter fixed head. Measure the resistance between TP1 and TP2 of 6AR1A2A2 (should be 1.5 ohm approx.). If the TP1 to TP2 test indicates open circuit, check circuit continuity of TP1 through to 6AR1A2A4J2 (fig. 6-14). If continuity test is normal, replace the output tube. (TM 11-5820-540-12). Test and troubleshoot 6AR1 output stage as described in paragraph 4-34.
	b. Defective filter assembly 6AR1A2A4 (fig. 3-6).	*b.* If power at 6AR1A2A4J2 is abnormal, measure power at P1 (6AR1A2A4J3). If normal, remove 6AR1A2A4 and test as described in paragraph 4-39.
	c. Defective drive amplifier stage of 6AR1A1.	*c.* Measure the power at 6AR1A2-A4J4. If normal, set test facility switch S13 to OFF and disconnect the transmitter fixed head. Measure the resistance between TP3 and TP4 of 6AR1A2A2 (should be 1.5 ohm approx.). If TP3 to TP4 test indicates open circuit, check continuity of circuit, check continuity of circuit TP4 through to 6AR1A2A4J4 (fig. 6-14).

Symptom	Probable cause	Checks and corrective measures
		If continuity test is normal, replace the driver tube (TM 11-5820-540-12). Test and troubleshoot the driver stage as described in paragraph 4-34.
	d. Defective filter assembly 6AR1A2A4 (fig. 3-6)	*d.* If power at 6AR1A2A4J4 is abnormal, measure power at P2 (6AR1A2A4J1). If normal, remove 6AR1A2A4 (refer to para 4-87) and test as shown in paragraph 4-39.
	e. Defective RF power level control 6A5 (fig. 3-6)	*e.* If power at P2 (6AR1A2A4J1) is abnormal, measure the power at 6A1J6. If normal, replace 6A5 (para 3-54).
6. LOW POWER lamp illuminated at channel 111 or 112.	Defective wiring 6W1J2 to 6AR1A2A3P1 or 6W1J1.	Check continuity between 6W1J2 to 6AR1A2A3P1 and 6WJ1.
7. No DRIVER CUR indication (*b*(2)(*g*) above).	*a.* V2 filament circuit shorting to ground.	*a.* Check C14 of 6AR1A1; replace necessary.
	b. C2 of 6AR1A2A2 shorting	*b.* Check C2; replace if necessary.
	c. V2 cathode circuit shorting to ground through C7, C8 or C10 of 6AR1A1.	*c.* Remove driver amplifer tube V2. Check from center conductor of P2 of 6AR1A1 to chassis ground.
8. No OUTPUT CUR indication (*b*(2)(*h*) above).	*a.* V1 filament circuit shorting to ground.	*a.* Check C13 of 6AR1A1; replace if necessary.
	b. C1 of 6AR1A2A2 shorting	*b.* Check C1; replace if necessary.
	c. V1 cathode circuit shorting to ground through C7, C8, or C4 of 6AR1A1.	*c.* Remove output tube V1. Check for short circuit to ground on center conductor of P1 of 6AR1A1.

4–30. Electronic Switch 6A1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V).	Accessory kit
Drive Generator Sierra 470A-500.	Power signal source
Wattmeter AN/URM-98	Power meter
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) *Relay check.*

(*a*) Connect the unit under test to test facility connector J34.

(*b*) Set test facility switch S1 to ON and switch S26 to 20V.

(*c*) Set test facility switch S27 to position A; test facility lamp A should light.

(*d*) Set switch S27 to position B; lamp B should light.

(*e*) Set switch S26 to OFF.

(2) *Input switching circuit check.*

(*a*) Connect the test equipment as sho in figure 4–54.

(*b*) Set the 50-db variable attenuator 10 db and the 1-db variable attenuator to 0

(*c*) Set the power signal source to MHz at +20 dbm.

(*d*) Set test facility switch S26 to ON switch S27 to position A.

(*e*) Set the coaxial switch to positio and adjust the power signal source output to tain a +10 dbm indication on the power mete

(*f*) Set switch S27 to position B. signal level measured on the power me should be less than –15 db, indicating a reject greater than 25 db.

(*g*) Return the power meter range swi to +10 dbm and test facility switch S27 to posit A.

(*h*) Set the coaxial switch to position 1.

(*i*) Adjust the 1-db variable attenuator bring the power meter indication back to + dbm. The increase in attenuation, as indicated the setting of 1 db on the variable attenuat represents the insertion loss of the module un test. The insertion loss should be less than 0.3

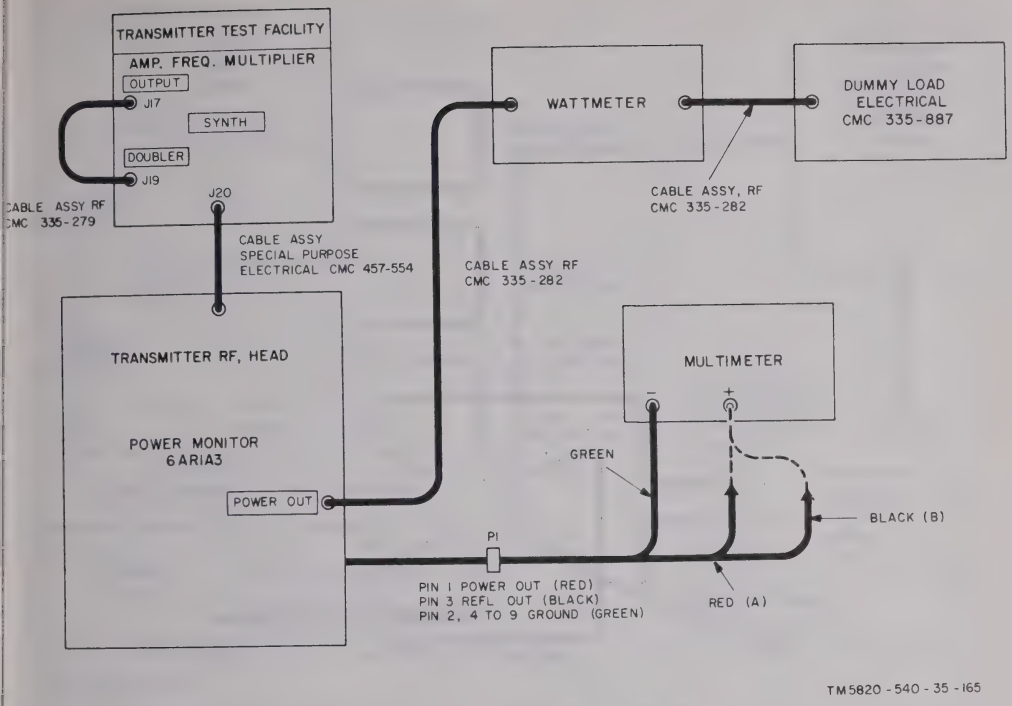


Figure 4-53. Power monitor 6AR1A3, PWR OUT and REFL PWR metering currents, test setup.

(*j*) Set switch S26 to position OFF. Re- the 1-db variable attenuator to 0 db.

(*k*) On the unit under test, disconnect the e from J4 and connect it to J2, after remov- the 50-ohm load. Terminate J4 with the 50- load.

(*l*) Set switch S26 to ON and S27 to ition A. The signal level measured on the er meter should be less than –15 db, indicat- a rejection greater than 25 db.

(*m*) Return the power meter range switch +10 dbm and test facility switch S27 to posi- B.

(*n*) Set the coaxial switch to position 1.

(*o*) Adjust the 1-db variable attenuator to ng the power meter indication back to +10 n. The increase in attenuation, as indicated by setting of the 1-db variable attenuator, should less than 0.3 db.

(*p*) Set switch S26 to OFF. Reset the b variable attenuator to 0 db.

(3) *Output switching circuit check.*

(*a*) On the unit under test, disconnect cables from J2 and J5 and reconnect them J6 and J3 respectively. Terminate J5 and J2 h the 50-ohm loads removed from J6 and J3.

(*b*) Tune the power signal source to 250 MHz at +20 dbm; repeat (2) (*d*) through (*i*) above.

(*c*) Repeat (*b*) above with the power signal source tuned to 350 MHz and 400 MHz in turn.

(*d*) On the unit under test, disconnect the cable from connector J3 and connect it to J1. Terminate J3 with the 50-ohm load removed from J1.

(*e*) Repeat (2) (*l*) through (*o*) above at 250 MHz, 350 MHz, and 400 MHz.

(*f*) Set switch S26 to OFF.

(4) *Meter circuit check.*

(*a*) Connect the test equipment as shown in figure 4–55.

(*b*) Tune the power signal source to 400 MHz and reduce the output to zero.

(*c*) Set switch S27 to position B; S20 switch to position S26; and S26 switch to ON.

(*d*) Increase the output of the power signal source to 200 mw. The test facility meter M1 should indicate at least 10 percent of full scale.

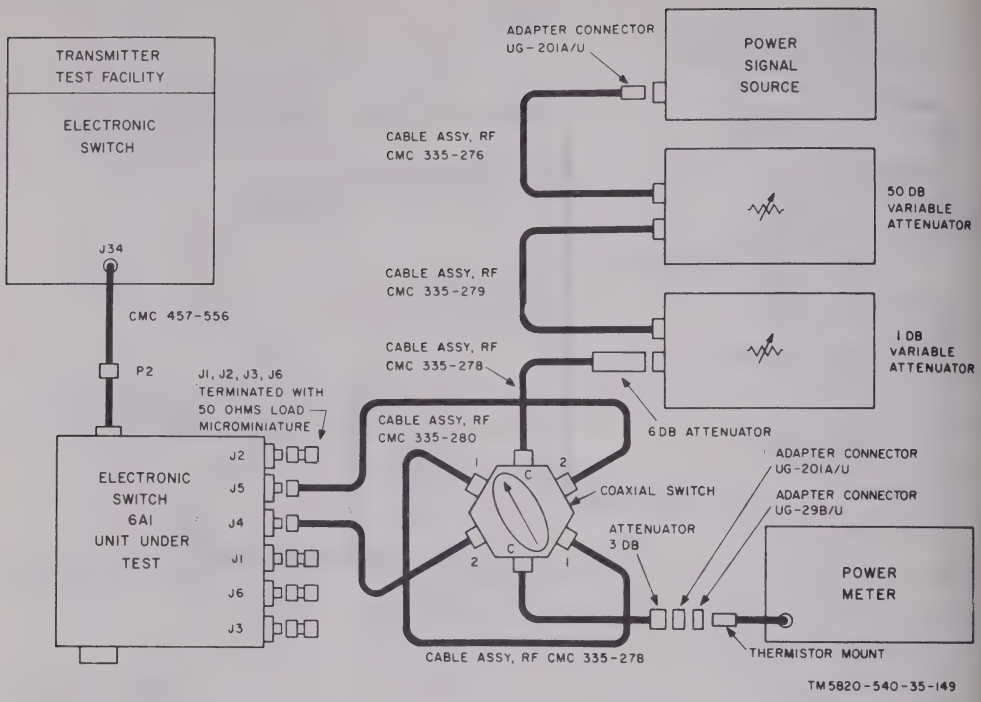


Figure 4-54. Electronic switch 6A1, insertion loss and rejection check, test setup.

c. Troubleshooting (fig. 6-16).

(1) *Relay check.*

Symptom	Checks and corrective measures
Lamp A or B does not light	Check the operation of relay K1 (fig. 4-56); check relay contacts for open circuit. Replace relay if necessary.

(2) *Input switching circuit check.*

Steps (*e*) and/or (*t*); no output.	*S27 switched to A:* Check CR2 for open circuit. Check continuity of circuit wiring from J5 to J4. *S27 switched to B:* Check CR4 for open circuit. Check continuity of circuit wiring from J5 to J2.
Step (*f*); low rejection	*S27 switched to B:* Check diode CR2 for shortcircuit. Check continuity of control line from relay contact A2 through L1 to CR2.
Step (*l*); low rejection	*S27 switched to A:* Check diode CR4 for shortcircuit. Check continuity of control line from relay contac B2 through L2 to CR

CAUTION

If CR2 shortcircuits L1, CR4 and L2 will burn out when unit is switched to tripler circuit (S27 position B). Similarly, if CR1 shortcircuits L1, CR2 and L2 will burn out with S27 in position A.

Step (*i*): high insertion loss.	*S27 switched to A:* Check diode CR2 forw and reverse resistance. Replace diode if necessary.
Step (*o*): high insertion loss.	*S27 switched to B:* Check diode CR4 forw and reverse resistance. Replace diode if necessary.

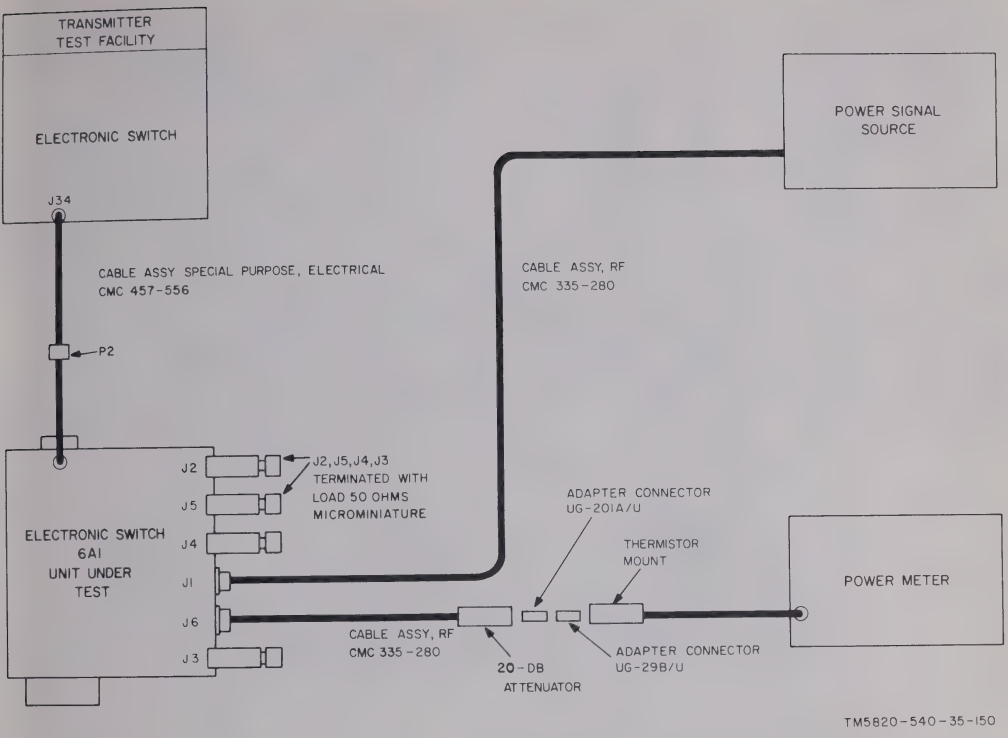


Figure 4-55. Electronic switch 6A1, power monitoring check, test setup.

(3) *Output switching circuit test.*

utput	*S27 switched to A:* Check CR3 for open circuit. Check continuity of circuit wiring from J3 to J6. *S27 switched to B:* Check CR5 for open circuit. Check continuity of circuit wiring from J1 to J6.	Check diode CR5 forward and reverse resistance. Replace diode if necessary.
rejection	*S27 switched to B:* Check diode CR3 for shortcircuit. Check continuity of control line from relay contact B2 through L3 to CR3. *S27 switched to A:* Check diode CR5 for shortcircuit. Check continuity of control line from relay contact A2 through L4 to CR5.	
insertion loss	*S27 switched to A:* Check diode CR3 forward and reverse resistance. Replace diode if necessary. *S27 switched to B:*	

(4) *Metering circuit check.*

No indication on test facility meter M1.	Check diode CR1 for open or shortcircuit. Replace diode if necessary. Check the continuity of meter circuit from C1 to P2 pin 4. Restore connection if necessary.

4-31. Frequency Multiplier Assembly 6A2

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set	Accessory kit

Common name	Equipment
MK-1173(V)1/ GRM-95(V).	
Generator, Signal AN/USM-44A.	Signal Generator
Wattmeter AN/URM-98	Power meter
Generator, Signal AN/USM-205.	Wide range oscillator
Oscilloscope AN/USM-281	Oscilloscope
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) *Preliminary check.*

(*a*) Remove the cover from the unit under test.

(*b*) Check for broken or loose wires, or dirt inside variable air-dielectric capacitors C4, C8, and C3 (fig. 4–57). Check the three gears on the capacitor tuning shafts to insure that their setscrews are secure.

(*c*) Place the unit under test on the t facility frequency multiplier test stand (part the accessory kit) and engage the shaft of module to the mechanical counter.

(*d*) Turn the mechanical counter knob til capacitors C4 and C8 are in their maxim capacitance position (fully meshed) as shown figure 4–58A. Should capacitors C4 and C8 be in their fully-meshed position together, p ceed as follows:

NOTE

One setscrew on each C4 and C8 gear shaft should be accessible from the side of the module

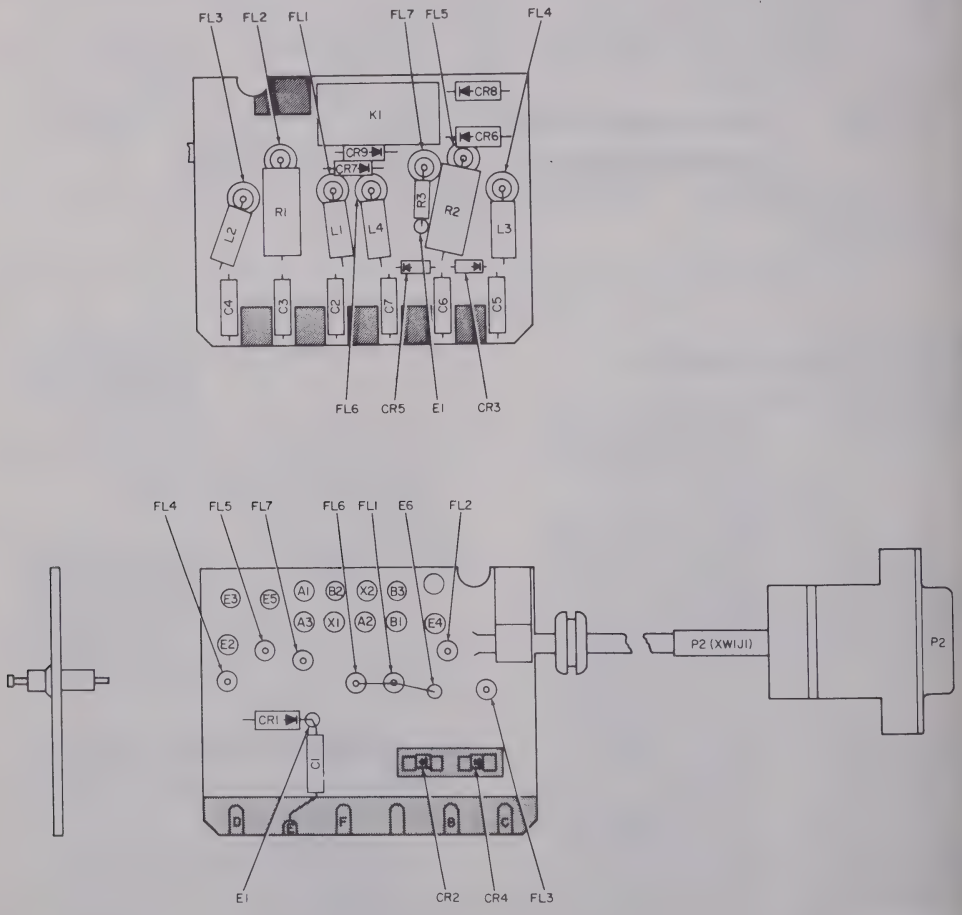


Figure 4-56. Electronic switch 6A1A1, parts location.

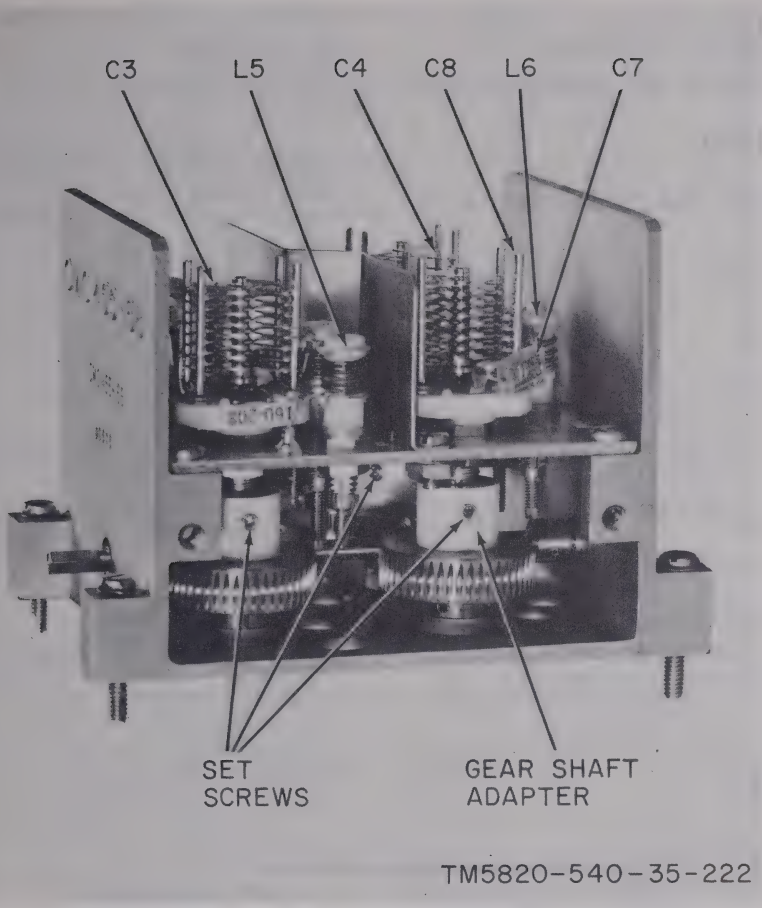


Figure 4-57. Frequency multiplier assembly 6A2, side view (cover removed).

1. Remove the module from the frency multiplier test stand if necessary. osen the setscrews on the gear shaft adapter he capacitor not fully meshed.

2. Set the rotor of the capacitor to the y-meshed position and tighten the setscrews.

3. Turn the drive shaft back and forth l check to see that C4 and C8 go through ir maximum capacitance together.

(*e*) Turn the drive shaft 2 1/2 turns ccw m the maximum capacitance position of C4 and . Capacitor C3 should be at its minimum caitance (fully open) position as shown in ure 4–58B. If C3 requires adjustment, proceed follows:

1. Loosen the setscrews.

2. Set the rotor to its fully open position and tighten the setscrews.

(*f*) If C4, C8, and/or C3 required adjustment, proceed with adjustment procedures as described in *d* below.

(2) *Performance checks.*

(*a*) Reset capacitors C4 and C8 to their maximum capacitance position.

(*b*) Remove the unit under test from the frequency multiplier test stand and set the counter to **991.80.**

(*c*) Replace the unit on the frequency multiplier test stand. Do not rotate the drive shaft while engaging the counter.

(*d*) Connect the four coaxial cables from the unit to the corresponding connectors on the frequency multiplier test stand.

(*e*) Connect the test equipment as shown in figure 4–59.

(*f*) **Deleted.**

(*g*) Set the test facility switches as follows:

Switch	Switch position	Normal indication
S1	ON	
S20	S12	
S18	61.66	
S12	OSC	Meter M1 reads 20% to 90% fullscale.
S12	DBLR	Meter M1 reads 20% to 90% fullscale.
S26	ON	
S27	B	B lamp lights

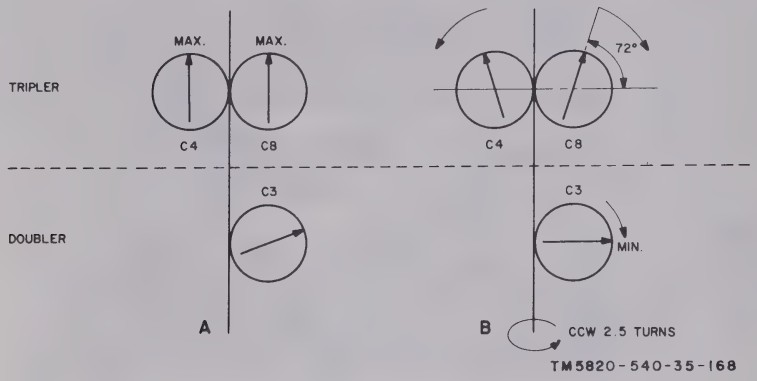


Figure 4–58. Preliminary setting of variable air dielectric capacitors.

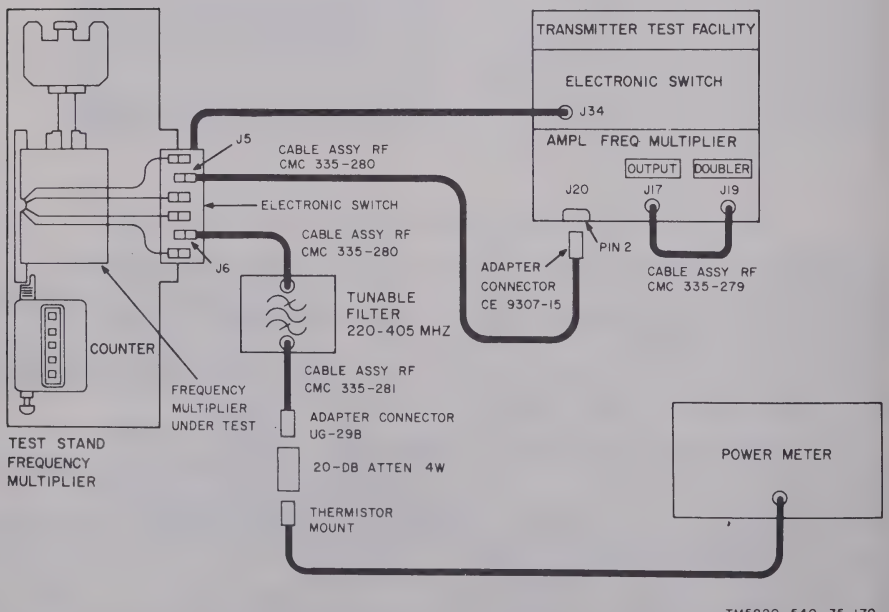


Figure 4–59. Frequency multiplier assembly 6A2, performance check, test set-up.

(*h*) Turn the shaft until the counter indi-
es **982.76** (corresponding to channel 340).

(*i*) Tune the filter to 370 MHz; adjust
lightly to obtain a maximum indication on the
ower meter. The level should not be less than
40 mw.

(*j*) Turn the shaft until the counter indi-
s **992.11** (corresponding to channel 140).

(*k*) Set test facility switches S18 to 67.50
nd S27 to position A. Test facility lamp A
hould light.

(*l*) Tune the filter to 270 MHz and ad-
ust slightly to obtain a maximum indication on
he power meter; the level should not be less
han 440 mw.

(*m*) If normal indications are obtained in
h) through **(k)** above, turn the shaft until the
ounter indicates **982.76.**

(*n*) Carefully remove the unit from the
requency multiplier test stand and secure the
haft with a clamp.

c. Troubleshooting.

Symptom	Checks and corrective measures
Step (*b*) (2) (*i*) above: no output, tripler circuit.	Check diode CR2 (fig. 4-60) for short or open circuit; replace diode if necessary. Check for short or open circuit at P3 or P4 connectors. Replace the defective component or restore connections as required.
Step (*b*) (2) (*m*) above: no output, doubler circuit.	Check diode CR1 for short or open circuit; replace diode if necessary. Check for short or open circuit at P1 or P2 connectors. Replace the defective component or restore connections as required.
Step (*c*) (2) (*i*) and/or (*m*): low output, tripler or doubler circuit.	Check the alignment of the module under test as described in *d* and *e* below.

d. Tuning Procedures, Tripler Circuit.

(1) Reset capacitors C4 and C8 to their maximum capacitance position.

(2) Remove the unit under test from the frequency multiplier test stand and set the counter to **991.80.**

(3) Replace the unit under test on the frequency multiplier test stand. Do not rotate the drive shaft while engaging the counter.

(4) Connect the four coaxial cables from the unit under test to the corresponding connectors on the frequency multiplier test stand.

(5) Connect the test equipment as shown in figure 4–61.

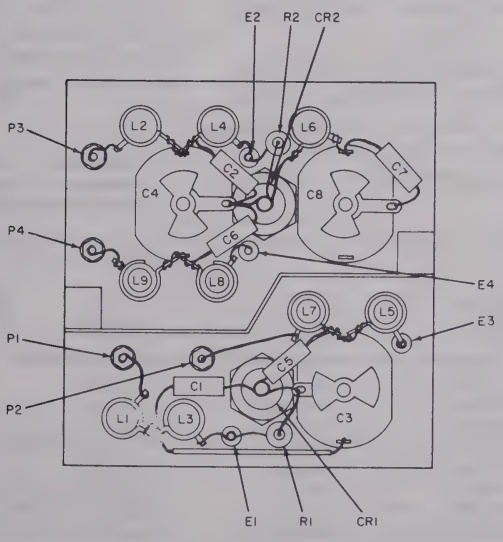


Figure 4-60. Frequency multiplier assembly 6A2A1, parts location.

(6) Reduce the output level of the wide range oscillator and the signal generator to zero.

(7) Set the test facility switches as follows:

Switch	Switch position	Normal indication
S1	ON	
S20	S12	
S18	61.66	
S12	OSC	Meter M1 should indicate 20% to 90% of full scale.
S12	DBLR	Meter M1 should indicate 20% to 90% of full scale.
S26	ON	
S27	B	Lamp B should light.

(8) Turn the shaft until the counter indicates 982.76 (corresponding to channel 340).

(9) Tune the filter to 370 MHz; and adjust slightly to obtain a maximum indication on the power meter. The power meter indication should not be less than 440 mw.

(10) Adjust L2–L4 and L8–L9 (fig. 4–60) for maximum power indication on the power meter. L2–L4 and L8–L9 are matching pairs and must be adjusted together.

NOTE

On this set-up the signal generator is used as a marker generator.

(11) Adjust the signal generator to the frequency of the unit under test as indicated by the beat frequency on the oscilloscope. Set the signal generator output level to 0 db.

(12) Adjust the frequency and output level of the wide range oscillator (2 kHz at 2 volts rms approximately), to obtain an adequate response curve and a correct phasing display on the oscilloscope, as shown as "permissable" in figure 4–62.

(13) Readjust L2–L4, L6, and L8–L9 to eli inate any kinks in the response.

(14) Reduce the wide range oscillator out to zero. The power meter indication should greater than 440 mw.

(15) Adjust the counter on the freque multiplier test stand to indicate 981.22 and test facility switch S18 to position 66.00.

(16) Tune the filter to 396 MHz.

(17) Adjust the signal generator to 396 M as indicated by the beat frequency on the osci scope. The power meter indication should greater than 600 mw.

(18) If the power is below 600 mw, readj L2–L4, L6, and L8–L9 slightly until a 600 indication is obtained.

(19) Readjust the frequency and/or out level of the wide range oscillator, if necessa to obtain an adequate response curve display the oscilloscope, shown as "permissable" figure 4–62.

NOTE

All power readings are made with the signal generator output control set to minimum.

(20) Tune the filter through the respo No break-up should occur at the center frequ cies, as shown as "not permissable" in fig 4–62.

(21) Repeat steps (15) through (20) ab for the remaining channels listed in the follow chart. Check and record the power and frequ cy response shape.

NOTE

Occasionally a slight adjustment of coils my be necessary to bring the power and response shape within specifications.

Tuning Law of Tripler Circuit: Tuning Range 290-405 MHz

Channel number (ref. only)	Output freq (MHz)	Counter setting	Test facility switch S18	Filter, signal generator setting (MHz)	Required outp power (mw)
180	289.98	989.79	48.33	289.98	440
208	303.90	988.31	50.65	303.90	440
228	313.86	987.35	52.31	313.86	440
260	329.88	985.90	54.98	329.88	440
299	349.50	984.27	58.25	349.50	440
340	369.96	982.76	61.66	369.96	440
360	380.76	982.04	63.46	380.76	500
392	396.00	981.22	66.00	396.00	595
410	405.00	980.77	67.50	405.00	650

NOTE

Occasionally, it may happen that the specification at two or more points along the band cannot be met at the same time; that is, meeting the specifications at one channel makes it impossible to meet the specifications at the other channels. If such a case occurs, proceed as follows:

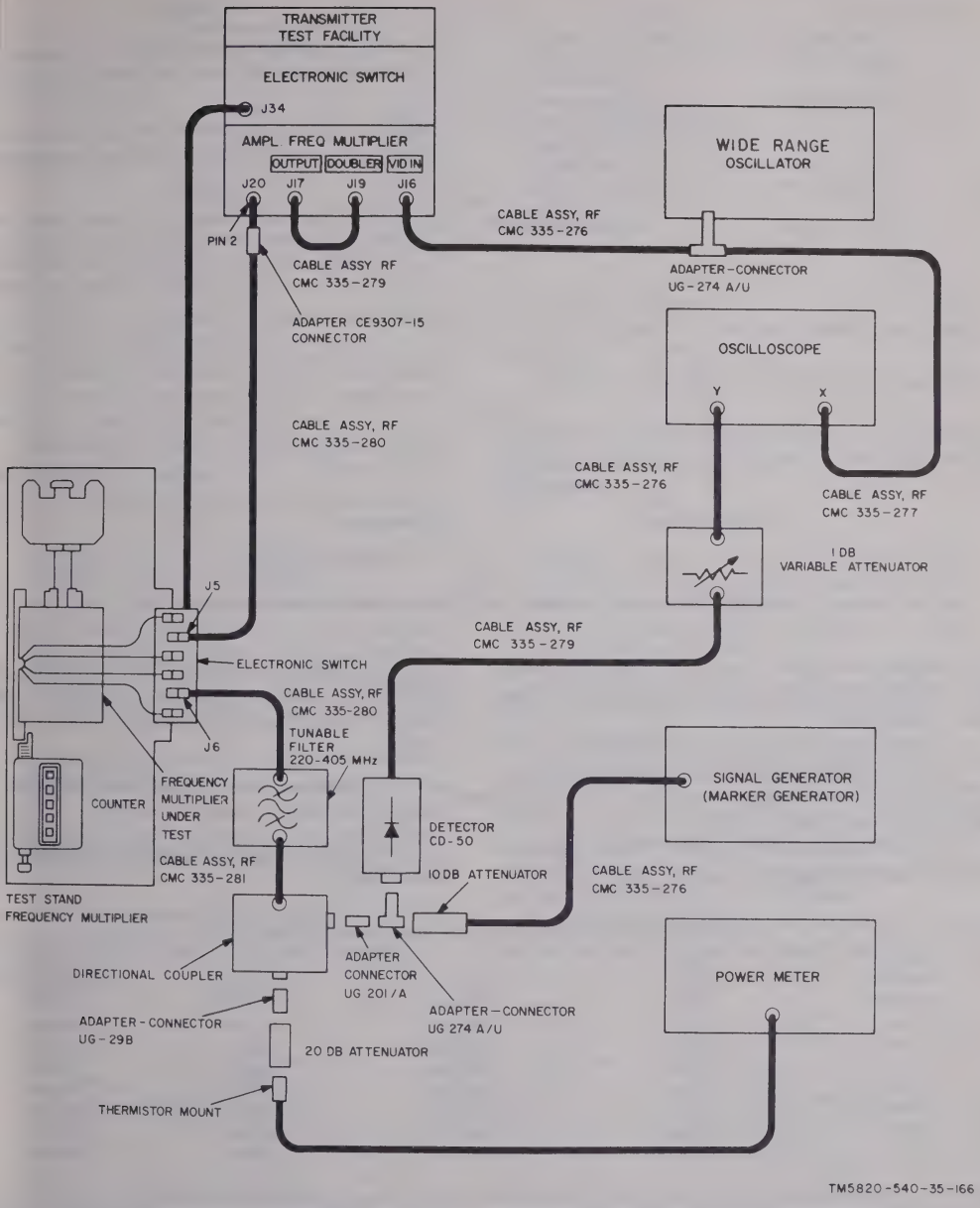


Figure 4-61. Frequency multiplier assembly 6A2, tuning procedure test set-up.

(*a*) Disconnect the drive shaft of the unit er test from the counter; turn the counter one clockwise and reconnect the drive shaft to counter.

(*b*) Turn the shaft until the counter indicates 982.76 corresponding to channel 340).

(*c*) Repeat the complete tuning procedures above, adjusting the coils as necessary. If the improvement is not sufficient, turn the counter one more turn cw and repeat the complete alignment procedure. Alternately, if the setting procedure in (*a*) above made things worse, turn

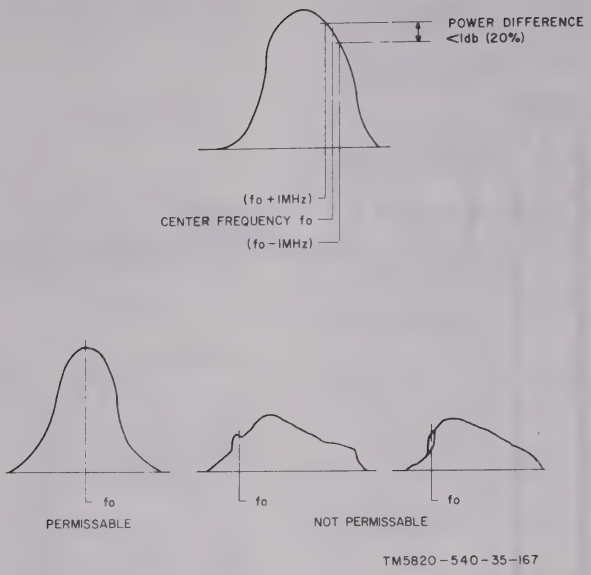


Figure 4-62. Frequency multiplier assembly 6A2, spurious test response pattern.

the counter two turns ccw (one turn ccw from its original setting) and repeat the complete alignment procedure.

e. Tuning Procedure, Doubler Circuit.

(1) Using the test set-up shown in fig. 4-61, adjust the test stand counter to **992.11 (corresponding to channel 140).**

(2) Set test facility switch S27 to position A; test facility lamp A should light.

(3) Tune the filter to 370 MHz and ad slightly to obtain maximum indication on power meter; the level should not be less 440 mw.

(4) Reduce the output level of the range oscillator to zero.

(5) Set the test equipment as shown in chart below.

Tuning Law of Doubler Circuit: Tuning Range 220 to 290 MHz

Channel number (ref only)	Output freq (MHz)	Counter Setting	Test facility switch S18	Filter and signal generator setting (MHz)
40	219.92	000.00	54.98	219.92
66	233.00	997.80	58.25	233.00
94	246.64	995.59	61.66	246.64
108	253.84	994.38	63.46	253.84
128	264.00	992.87	66.00	264.00
140	270.00	992.11	67.50	270.00
179	289.50	989.85	72.50	289.50

(6) Adjust coils L1-L3 and L5-L7 on the module under test for maximum power as indicated on the power meter. L1-L3 and L5-L7 are matching pairs and must be adjusted together.

(7) Adjust the frequency and output level of the wide range oscillator to obtain an adequate response curve and check the response pattern displayed on the oscilloscope, as shown as "permissable" in figure 4-62.

(8) Readjust coils L1-L3 and L5-L7 necessary, to improve or clean up the respo

(9) Record the power meter indicatio should be greater than 440 mw.

(10) Tune the filter through the respo No break-up should occur at center frequen as shown as "not permissable" in figure 4-6

(11) Repeat (4) through (10) above for remaining channels listed in the chart above

NOTE

ccasionally a slight adjustment of coils may be ecessary to bring the power and response shape ithin specifications.

2) Balance the power as closely as possi- etween channels 40 and 179.

NOTE

he output power in general drops very rapidly om about channel 160 to 179, therefore it may ot be possible to balance the power output be- veen channels 40 and 179.

3) If it is not possible to meet the above fications proceed as follows:

(*a*) Remove the cover of the unit under and loosen the set screws on the shaft cor- nding to the C3 capacitor.

(*b*) Turn the rotor of capacitor C3 cw pproximately 5 degrees.

(*c*) Tighten the setscrews and replace the .

(*d*) Repeat the complete tuning procedure e and adjust the coils slightly.

(*e*) If this adjustment does not result in improvement, remove the cover of the unit r test, loosen the shaft, and turn the C3 10 degrees ccw (5° ccw from its original g). Repeat the complete tuning procedure e.

(*f*) Adjust the rotor of capacitor C3 until the power output and the response pattern within specifications.

14) Typical final settings of the variable air ctric capacitors are shown in figure 4–63.

2. Control-Indicator 6A3 or 2A2

Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V).	Accessory kit
Gage, Thickness 0.003 in.	Feeler gauge
Wrench, torque	Torque wrench

b. Test Procedure.

(1) Connect the test equipment as shown in figure 4–64.

(2) Set test facility switches S1 and S6 to ON.

(3) Turn the thumb-wheel on the control-indicator test set until channel 40 is displayed in the window.

NOTE

The type number of the control-indicator must correspond to the type number displayed in the left hand window of the control-indicator test set. Unit 6A3 type number is 406–265/2. Unit 2A2 type number is 406–265/8.

(4) Turn the tuning control shaft on the unit under test so that the numeral counter indicates channel 40.

(5) Observe the light display on the control-indicator test set. Lamps not illuminated should correspond to the dots on the tape display.

(6) Repeat (3) through (5) above for the remaining channels (of type number 406–265/2 or 406–265/8) shown on the tape.

(7) Check the stop mechanism by turning the tuning control shaft to the limits past channel

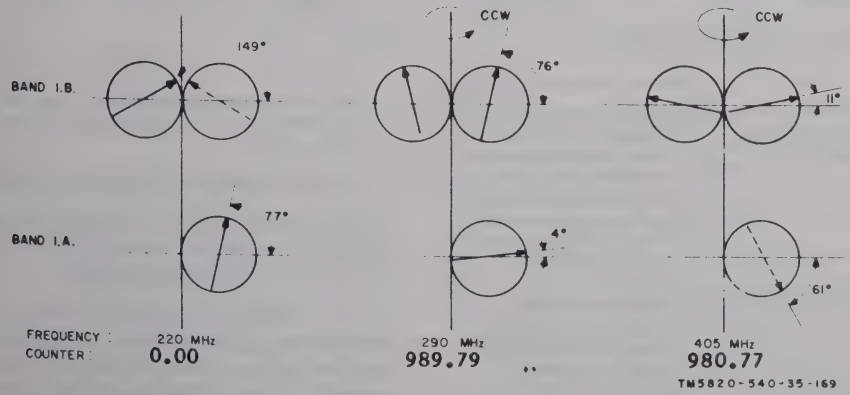


Figure 4-63. Final setting (typical) of variable air dielectric capacitors.

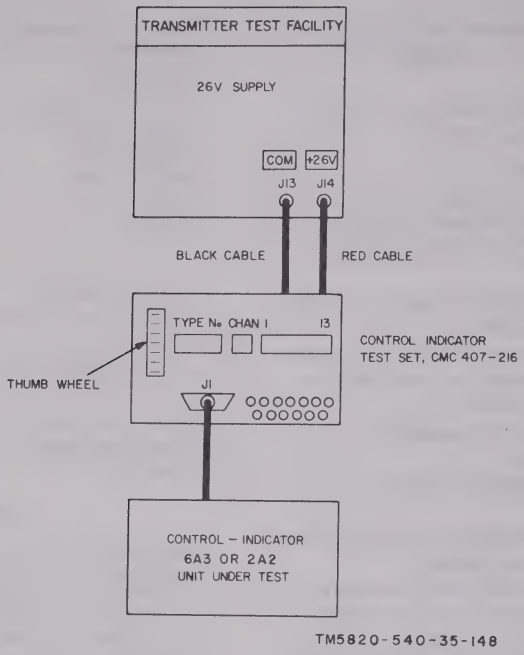


Figure 4-64. Control-indicator 6A3 or 2A2, test set-up.

40 and channel 410. At these points, the slipping clutch should operate to stop further movement of the gears.

CAUTION

Do not exert undue force on the mechanism if the clutch does not slip. Readjust the clutch nut as described in *d* below. If the stop mechanism or gears are broken return the unit to depot for repairs.

c. Troubleshooting (fig. 6–15).

Symptom	Checks and corrective measures
Faulty indication: one or more lamps No. 2 thru 13 not illuminated.	Remove the cover of the unit under test. Manually operate the switch corresponding to the non-operating lamp; this can be done by gently pushing the ball associated with the switch (fig. 4-65). If the lamp lights while manually operated, readjust the switch operating point as described in *d* below. If the lamp does not light while manually operated, replace the faulty switch
Faulty indication: one or more lamps No. 2 thru 13 permanently illuminated.	Check for a sticking b associated with the permanently lit lam
Lamp No. 1 permanently on or not illuminating (6A3 only).	Check adjustment of t switch operating po Replace command sig coder 6A3A2.

NOTE

Indicator lamp 1 corresponds to control line 13, indicator lamp 2 corresponds to control line 12 and so on.

d. Switch and Tuning Control Adjustments.

(1) Check to see that the spring lockwas under the mounting screw (figure 4–65, sect A–A) is not fully compressed.

(2) Adjust the contact points of switc by rotating the adjusting screw clockwise counterclockwise until the switch contact is j operating (lamp illuminated) with the ball r ing on the crest of the cam. Tighten the mou ing screw at this position.

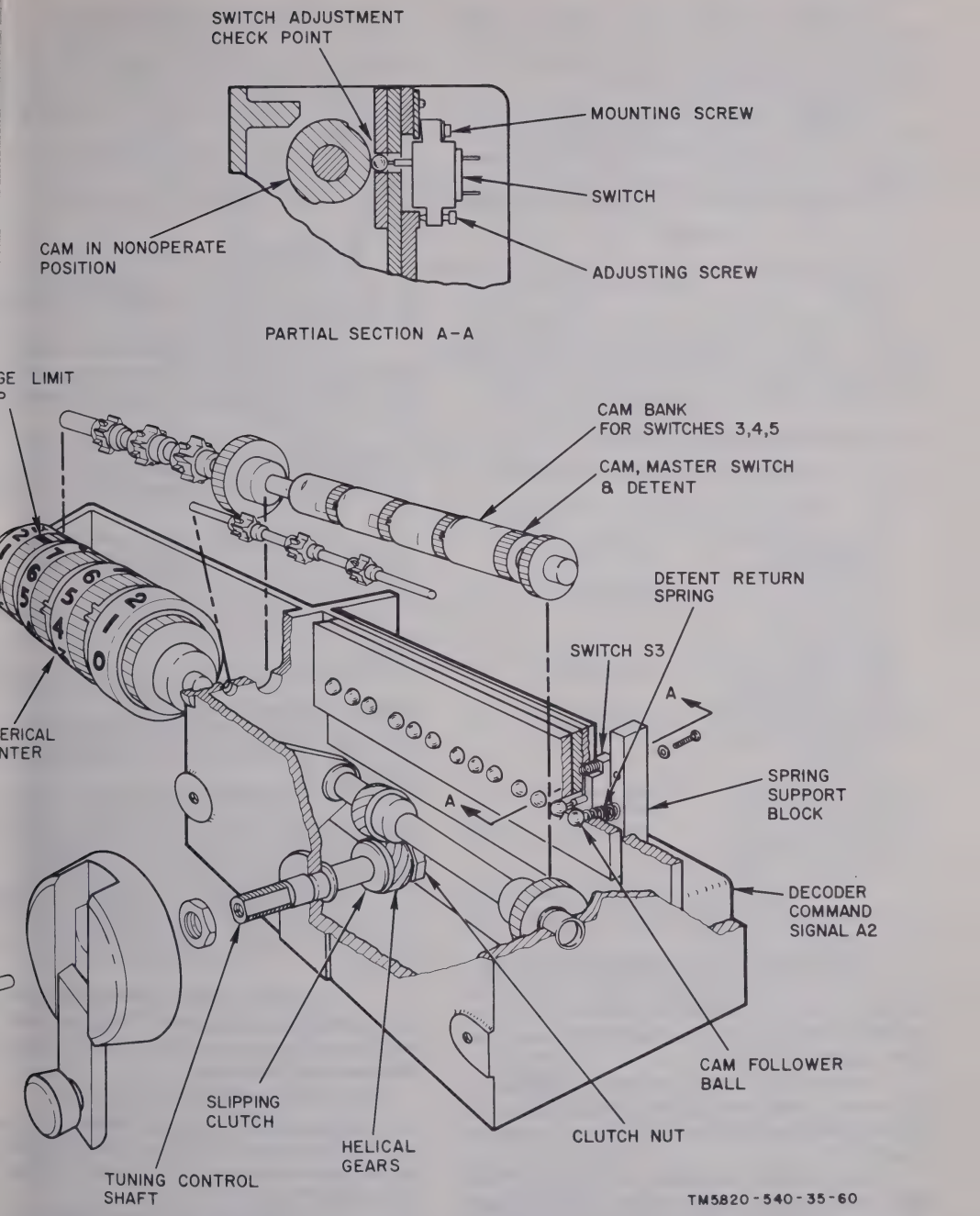


Figure 4-65. Control-indicator 6A3 or 2A2, cutaway view.

(3) Rotate the adjusting screw 2 turns counterclockwise and then tighten the mounting screws again. Lock both screws using liquid sealant glyptol or similar (see para 4–12).

(4) Check to see that the ball has a minimum of 0.003 in. residual travel clearance from the crest of the cam by inserting a feeler gauge between the ball and the cam; there should be no undue resistance to the movement of the ball.

NOTE

This check is done with the switch in the operate position.

(5) Use a torque wrench and check to see that the slip torque between the helical gear and the tuning control shaft is 70 ± 5 ounce/inches. Adjust the clutch nut if required.

4–33. RF Power Level Control 6A5

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V)	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit
Generator Sweep Signal AN/USM-203	Sweep generator
Oscilloscope AN/USM-281	Oscilloscope
Indicator, Standing Wave Ratio AN/UPM-108	VSWR amplifier
Wattmeter AN/URM-98	Power meter
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) *Insertion loss check.*

(*a*) Connect the test equipment as shown in figure 4–66. Do not connect the unit under test to the test facility.

(*b*) Set the coaxial switch to position 1.

(*c*) Set the sweep generator to 220 MHz cw and adjust for maximum output. Note the reference output level on the db scale of the power meter.

(*d*) Set the coaxial switch to position 2. The power meter should indicate 3.0 db ±0.5 db less than the reference reading obtained in (*c*) above.

(*e*) Connect the black plug of the test cable from the unit under test to connector J13 of the test facility and connect the red plug to connector J14 as shown in figure 4–66.

(*f*) Set test facility switches S1 and S6 to ON. The power meter indication should drop by more than 10 db.

(*g*) Remove the red plug from test cility connector J14; the power meter indica should return to the level observed in (*d*) ab

(*h*) Connect the red plug to test fac connector J59; the power meter indication sh not change.

(*i*) Repeat (*a*) through (*h*) above at MHz and 405 MHz.

(*j*) Set test facility switches S1 and S OFF.

(2) *Vswr check, diodes turned off.*

(*a*) Connect the test equipment as sh in figure 4–67. Do not connect the unit u test to the test facility.

(*b*) Set the sweep generator sweep w control to 1/4-turn from minimum and set frequency to 220 MHz. Return the sweep erator to SWEEP.

(*c*) On the sweep generator adjust level control for 1 mw at the Z2 port of the v detector as indicated on the power meter (fig 67A).

(*d*) Disconnect the power meter f port Z2 of the vswr detector and replace it v the 1.75:1 calibrated mismatch (fig. 4–67B).

(*e*) Set the oscilloscope horizontal sw control to EXTERNAL and the Y and X in to DC.

(*f*) Adjust the level limit control on sweep generator for flatness.

(*g*) Adjust the oscilloscope vertical trol until the baseline trace is on the baselin the graticule.

(*h*) Adjust the oscilloscope vertical se tivity control so that the second trace is at a venient level (e.g., top of the graticule). T second trace represents the vswr limit.

(*i*) Disconnect the calibrated misma from port Z2 of the vswr detector and con connector P1 of the unit under test to Z2 4–67C).

(*j*) Slowly rotate the sweep generator from 220 MHz to 405 MHz. The vswr displa on the oscilloscope should not exceed the limit set in (*h*) above.

(3) *Vswr check, diodes turned on.*

(*a*) Connect the unit under test to test facility as shown in figure 4–67. Connect black plug to connector J13 and the red p to connector J14.

(*b*) Connect the 2.5:1 calibrated m match at port Z2 of the vswr detector (fig. 67B).

(*c*) Repeat (*f*) through (*h*) in (2) ab to establish a baseline and reference line co

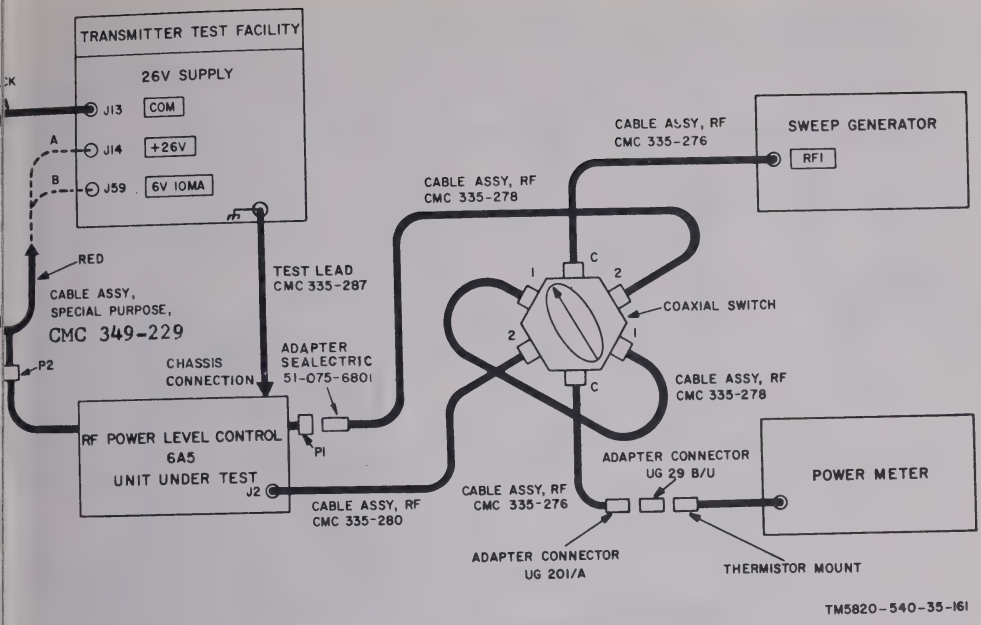


Figure 4-66. Rf power level control 6A5, insertion loss check, test set-up.

ding to a vswr of 2.5, with the sweep generr tuned to 200 MHz.

(*d*) Remove the 2.5:1 calibrated mismatch reconnect connector P1 of the unit under test 2 (fig. 4–67C).

(*e*) Set test facility switches S1 and S6 to

(*f*) Slowly rotate the sweep generator dial 1 220 MHz to 405 MHz and observe the vswr ations displayed on the oscilloscope. There ld be no peaks above the 2.5:1 reference line.

(*g*) Set test facility switch S6 to OFF. *Troubleshooting* (fig. 2–53).

(1) *Insertion loss check:*

Symptom	Checks and corrective measures
(*d*): high sertion loss.	Check CR1 (fig. 4-68) forward and reverse resistances. Replace diode if necessary. Check circuit wiring from P1 through J2 for loose connections or partially shorted cables. Repair as required.
(*d*): no output	Check for shortcircuit at P1, R1, CR1, C1, C2, and J2. Replace as required.
(*f*): no signal ontrol	Check CR2 for open circuit. Replace if necessary. Check continuity of circuit from CR1 to P2. Repair as required.
Step (*f*): no output	Check CR2 for shortcircuit. Replace if necessary.

(2) *Vswr check.*

Symptom	Checks and corrective measures
Step (*j*): diodes turned off high vswr	Check P1 and its cable, R1, R2, and C1. Replace or repair as required.

4–34. Radio Frequency Amplifier 6AR1

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Transmitter TS2866(V)1/GRM-95(V)	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V)	Accessory kit
Wattmeter AN/URM-98	Power meter
Counter, Electronic Digital Readout AN/USM-207	Counter
Multimeter TS-352B/U	Multimeter
Drive Generator Sierra 470A-500	Power signal source

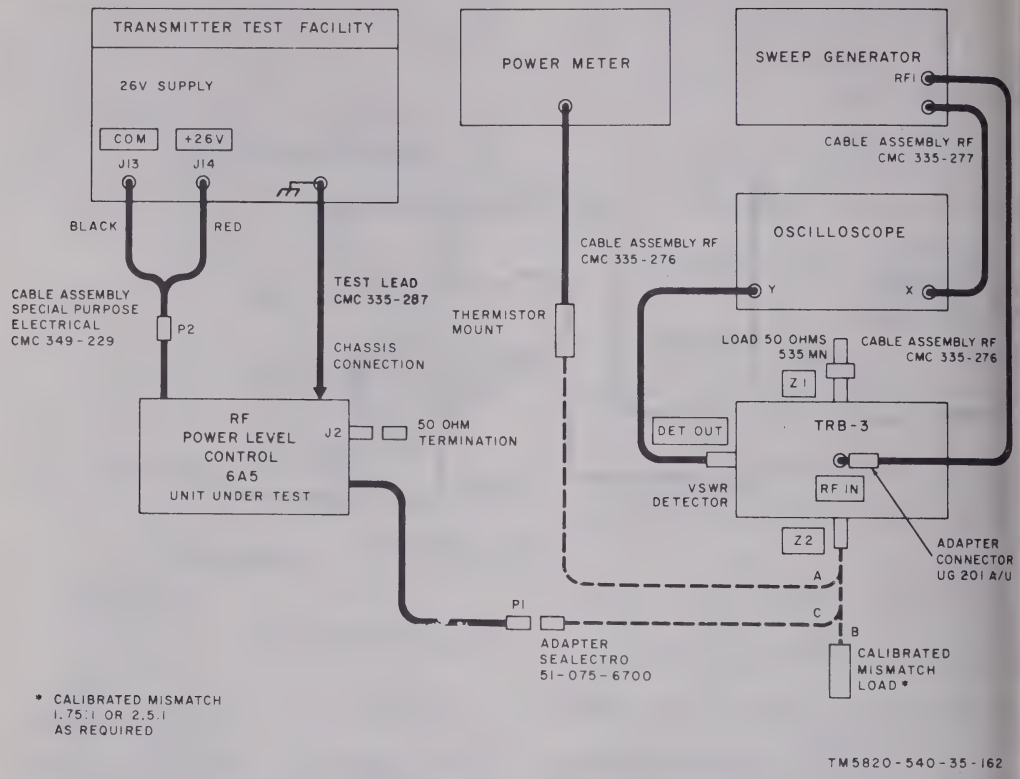


Figure 4-67. Rf power level control 6A5, input vswr check, test set-up.

b. Test Procedure.

(1) *Preliminary set-up procedure.*

(*a*) Disconnect cable 6AR1W1 from J1 connector of 6AR1A1 and J3 connector 6AR1A2-A4.

(*b*) Connect the test equipment as shown in figure 4-69 but do not connect the power signal source at this time.

(*c*) Connect the flexible cooling air extension pipe to the test facility and place the nozzle on its stand behind the unit under test.

(*d*) Set the test facility switches as follows:

Switch	Position	Normal indication
S1	ON	
S16	OUTPUT NORMAL	
S12	Away from OFF	
S13	ON	LOW PWR lamp should light
S20	+12v	Meter M1 should indic in green band
S20	+28v	Meter M1 should indic in green band
S20	+600v	Meter M1 should indic in green band

(2) *Filament voltage, tube current, emission check.*

(*a*) Set test facility switches S20 to S12 to REF, and note the indication on meter

(*b*) Connect unit under test TP1 (+) TP2 (–) to test facility connectors J18(+) J15(–).

(*c*) Set switch S12 to FIL V and ad unit under test R4 FIL to the same indica noted in (*a*) above.

(*d*) Connect unit under test TP4 (+) TP3 (–) to test facility connectors J18 (+) J15 (–).

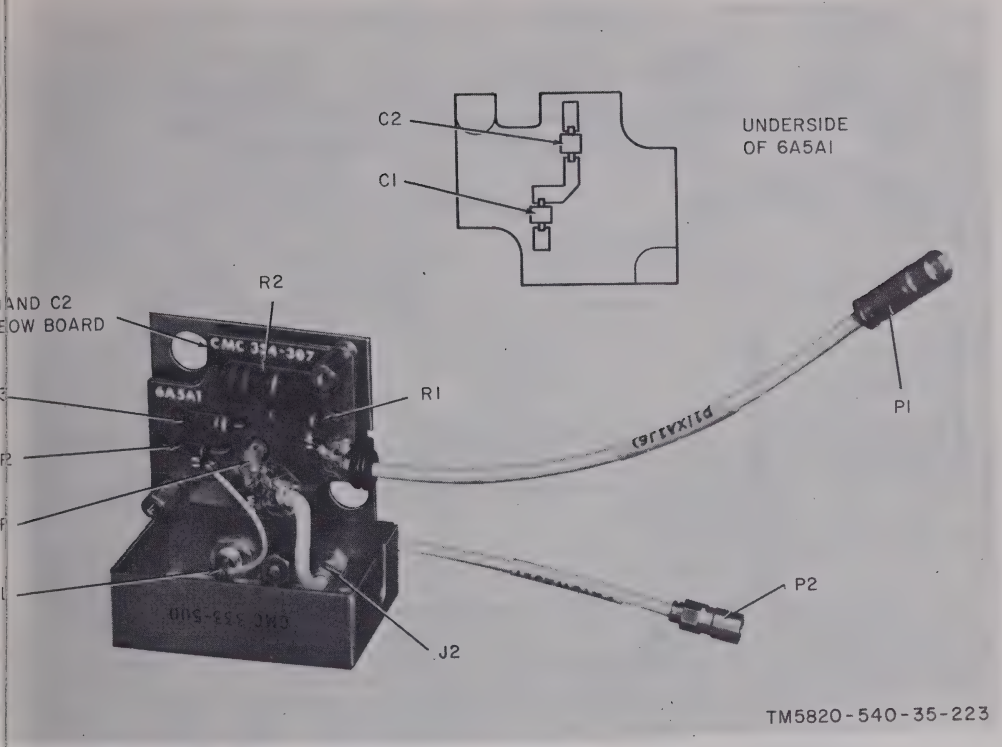


Figure 4-68. Rf power level control 6A5, parts location.

(*e*) Adjust unit under test R3 FIL to the indication noted in (*a*) above.

(*f*) Set switch S12 to DRIVER CUR and t R1 BIAS DRIVER for 50 percent of full on meter M1.

(*g*) Set switch S12 to OUTPUT CUR and t R2 BIAS OUTPUT for 50 percent of cale on meter M1.

(*h*) Set switch S12 to EMISSION and S15 tput. Tube warm-up time is at least 60 ds.

(*i*) Press switch S14 EMISSION for 15 ds and observe that meter M1 indicates e green band during the test.

(*j*) Set switch S15 to DRIVER, then press h S14 EMISSION for 15 seconds and observe meter M1 indicates in the green band during st.

(3) *Output amplifier.*

CAUTION

Do not allow the power signal source output to exceed 6 watts. Damage to unit under test may result.

(*a*) Connect the power signal source to the bidirectional coupler.

(*b*) Set the XMTR TUNE control on the unit under test to channel 320.

(*c*) Tune the power signal source frequency to 360 MHz ±0.1 percent. Use the counter to check the frequency (fig. 4–69A).

(*d*) Adjust the output level of the power signal source to obtain a 4-watt reading on the power meter (fig. 4–69B).

(*e*) Tune the XMTR TUNE control for a peak reading on the watt-meter.

(*f*) Pull out the unit under test PWR OUT PEAK control and adjust for maximum indication on the wattmeter. The level should be 35 watts or greater. Channel number 320 should not be more than 1/4-inch above or below the center of the unit under test XMTR TUNE window.

NOTE

If channel number 320 is more than 1/4-inch above or below the center of the XMTR TUNE window center line, adjust the display tape as shown in (*g*) below.

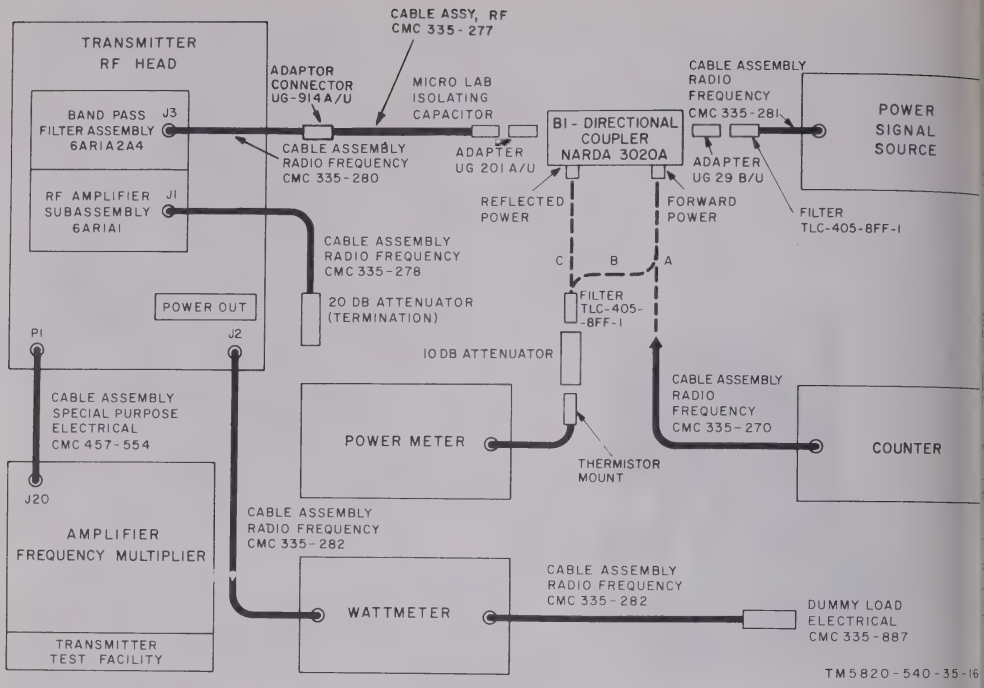


Figure 4-69. Radio frequency amplifier 6AR1 output power measurement test set-up.

NOTE

The tape is spring loaded and will turn if not held firmly.

(*g*) Remove the front panel of the unit under test. Hold the display tape firmly and remove the four red-circled mounting screws (fig. 4–70). Remove the display tape by carefully sliding the unit sideways without rotating the flexible shaft. Adjust the tape to indicate 320 at the calibration mark (notch) at the side of the display tape by turning the flexible shaft. Hold the tape and carefully slide the flexible shaft over the hexagonal shaft. Secure the display tape with the four screws provided. Replace the front panel.

(*h*) Connect the power meter to the reflected power port of the bidirectional coupler (fig. 4–69C). The reflected power indicated on the power meter should be less than 800 mw.

(*i*) Set test facility switch S13 to OFF.

(*j*) Reconnect cable 6AR1W1 to J1 connector of 6AR1A1.

(4) *Driver amplifier.*

(*a*) Connect the equipment as shown in figure 4–71.

(*b*) Set test facility switch S16 to DRIVER TEMPORARY.

(*c*) Check and reset, if required, the power signal source to 360 MHz ± 0.1 per at 4 watts (fig. 4–71A and B).

(*d*) On the unit under test, set the XMTR TUNE control to indicate 320 at the calibration mark.

(*e*) Set test facility switch S13 to ON. The wattmeter should indicate at least 30 watts.

(*f*) If the wattmeter indication is low, proceed as follows: Loosen the setscrews in two driver lead screw nuts (fig. 4–70) on the unit under test and adjust the lead screws and the PWR OUT PEAK control, in the push-in position, for a maximum power indication on the wattmeter. Try to obtain the required output with the PWR OUT PEAK control near the center of its operating range.

CAUTION

Maintain equal rotation of the adjustable driver lead screw nuts, otherwise the driver plate plunger will be misaligned.

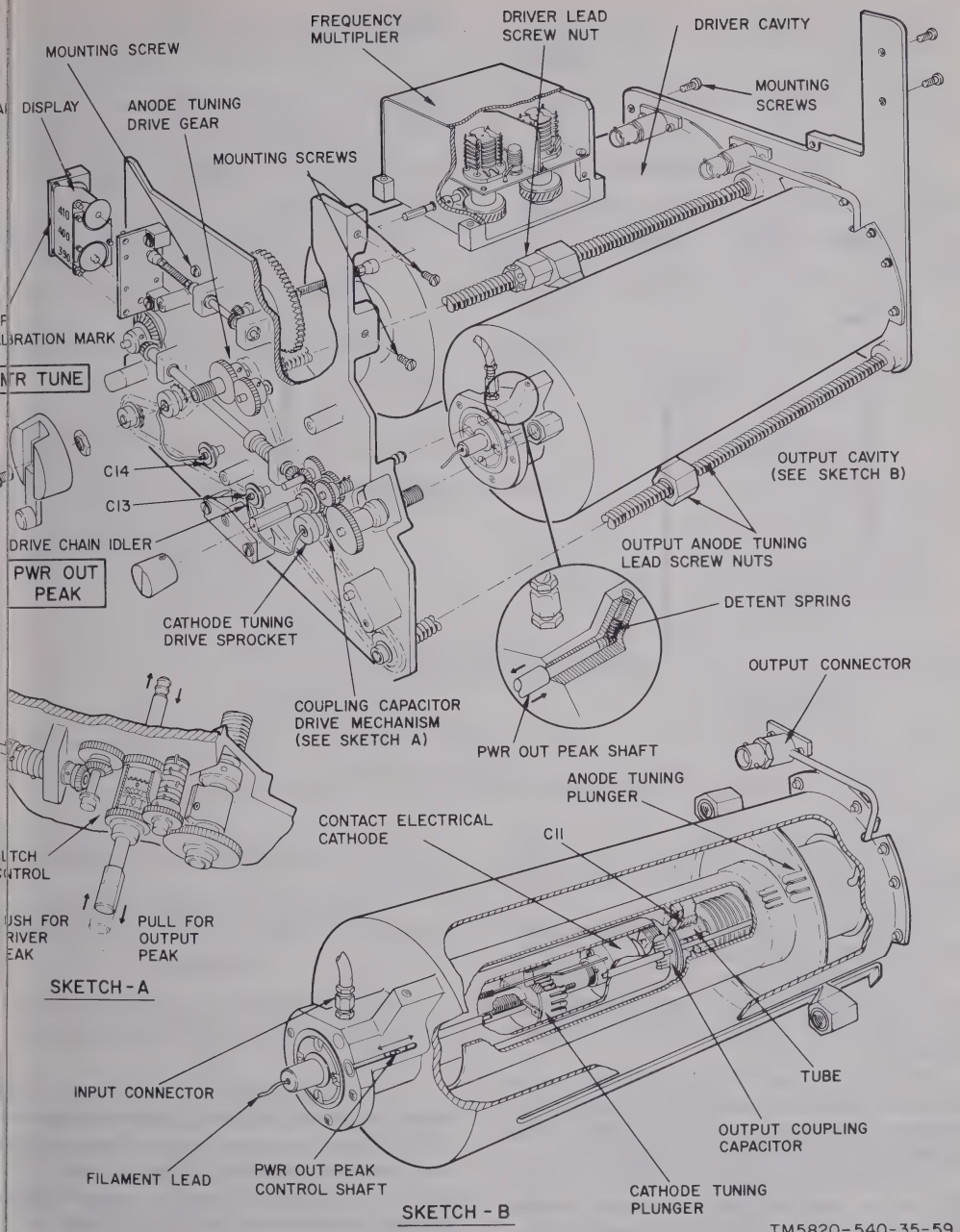


Figure 4-70. Radio frequency amplifier subassembly 6AR1A1 cut-away view of power amplifier tubes.

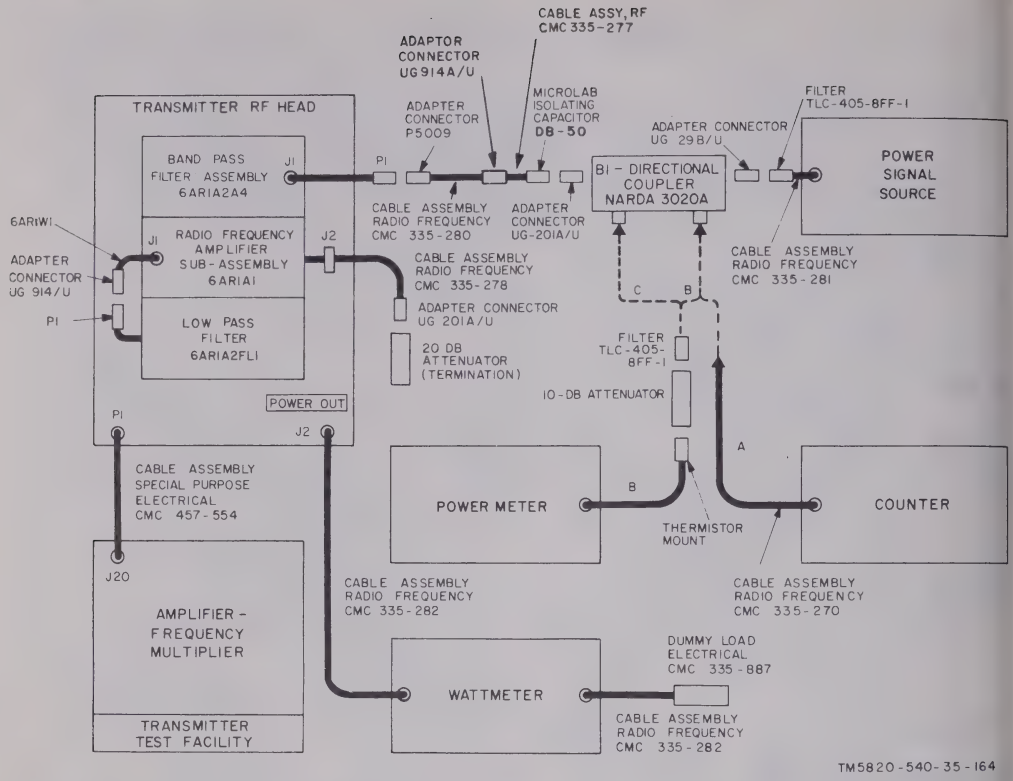


Figure 4-71. Radio frequency amplifier 6AR1, dirver amplifier check set-up.

(*g*) Tighten the setscrews on the driver lead screw nuts and seal with liquid sealant (Loctite Grade C).

(*h*) Set the XMTR TUNE control to indicate 410 at the calibration mark.

(*i*) Tune the power signal source frequency to 405 MHz ±0.1 percent and adjust the output level for a 4-watt indication (fig. 4-71A and B).

(*j*) Adjust the PWR OUT PEAK control, and the XMTR TUNE control if necessary, for a maximum indication on the wattmeter. The level measured should be at least 30 watts.

(*k*) Connect the power meter to the reflected power port of the bidirectional coupler (figure 4-71C). The indication should be less than 800 mw.

(5) *Tuning and power output check.*

(*a*) Modify the test set-up shown in figure 4-71 by using the 6AR1W1 cable to reconnect connector J1 of 6AR1A1 to connector J3 of 6AR1A2A4 and by connecting the P1 (6AR1A1-J2) lead from 6AR1A2FL1 to connector J2 6AR1A1.

(*b*) Connect the power signal source the driver amplifier at the P1 (6A5J2) lead.

CAUTION

Do not exceed the specified drive level as damage to the unit under test may result.

(*c*) Set the XMTR TUNE control to cha nel 40. Tune the power signal source to 2 MHz. Adjust the output level of the power sig source to 200 mw (fig. 4-71A and B).

(*d*) Set test facility switch S12 DRIVER, S16 to OUTPUT NORMAL, and S to ON.

(*e*) On the unit under test, adjust t PWR OUT PEAK (pushed-in) for a maximu indication on test facility meter M1.

(*f*) Set switch S12 to PWR OUT. Adju the PWR OUT PEAK (pulled out) for ma

n indication on meter M1 and the wattmeter. level measured on the wattmeter should be ast 35 watts.

(*g*) Set the XMTR TUNE control to dis- channel 40 one-half inch below the line on XMTR TUNE window.

(*h*) Repeat (*d*) through (*f*) above.

(*i*) Set the XMTR TUNE control to dis- channel 40 one-half inch above the line on TR TUNE window.

(*j*) Repeat (*d*) through (*f*) above.

(*k*) Repeat (*c*) through (*j*) above for all remaining channels listed in the chart below.

Channel	Frequency (MHz)	Output (watts)	Specified drive power (mw)
40	220	35	200
100	250	32	200
200	300	40	200
300	350	35	200
410	405	30	300

(*l*) Set test facility switch S13 to OFF.

Troubleshooting (fig. 2-35).

Symptom	Probable cause	Checks and corrective measures
ep *b* (2) (*i*); Meter M1 indication reduces.	Defective output tube V1	Replace output tube V1.
ep *b* (2) (*j*); Meter M1 indication reduces.	Defective driver tube V2	Replace driver tube V2.
ep *b* (3) (*e*); no output. No indication obtained on M1 with test facility switch S20 in positions +12V, +28V and 600V (*b* (1) (*d*)).	*a.* 600v line shorting to ground	*a.* Set switches S13 and S1 to OFF. Disconnect the 600v line to C5 and C11 at C15 and C16 (fig. 3-13). Check for short-circuit to ground on the 600v line to C5 and C11. Replace C5 or C11 if necessary as described in *d* below.
	b. Defective radio interference filter 6AR1A2FL3. (fig. 3-6).	*b.* Disconnect the 600v line to 6AR1A2FL3 at C15. Check and replace 6AR1A2FL3 if shorting to ground.
	c. C15 or C16 shorting to ground	*c.* Check C15 and C16 for short to ground. Replace as required.
	d. 600v arcing to C5 or C11	*d.* If above check is normal, set switches S20 to 600V, S1 to ON, and S13 to ON. If 600v is present but fails when M1 reading approaches the green band, proceed as follows: (1) Set S13 to OFF. (2) Disconnect the 600v line from C5 and C11 in turn. (3) Set S13 to ON. Check the 600V reading on M1. (4) If the 600V reading does not fail, reconnect the capacitor and repeat the test above. Replace as required.

l. Replacement of C5 or C11.

(1) Loosen the two captive screws and **move the air baffle assembly (fig. 3-13).**

(2) Insert the tube puller prong into the les in the top of the required tube and pull the be straight out from its socket.

(3) Loosen and remove the four screws that ure the tube anode clamp. Remove the tube ode clamp.

(4) Grasp the 600v wire and lift C5 or C11 aight up. Unsolder the capacitor.

(5) Solder the replacement capacitor to the 600v wire. Slide the capacitor back into position.

CAUTION

Be sure that the slot in the capacitor is centered around the rigid cable to the output connector.

(6) Replace the tube anode clamp and secure it with the four screws removed in (3) above.

(7) Replace the tube by pressing the cathode end into the tube socket. Check to see that the tube is firmly seated in the contact ring.

(8) Replace and secure the **air baffle assembly.**

4–35. Rf Amplifier Subassembly 6AR1A1

a. The rf amplifier subassembly includes the driver and output resonator cavities, the driver and output tubes, and associated tuning mechanism. Refer to chapter 5 for repairs and adjustments of the tuning mechanism.

b. The rf amplifier subassembly is part of radio frequency amplifier 6AR1. Refer to paragraph 4–34 for electrical testing and troubleshooting procedures.

4–36. Electronic Component Assembly 6AR1A2

Electronic component assembly 6AR1A2 includes circuit card assembly 6AR1A2A2, connector-filter assembly 6AR1A2A3, filter assembly 6AR1A2–A4, low pass filter 6AR1A2FL1, and radio interference filter 6AR1A2FL3. For testing and troubleshooting procedures of the above subassemblies refer to paragraphs 4–29, 4–34, 4–37, 4–38, and 4–39.

4–37. Circuit Card Assembly 6AR1A2A2

This unit includes the elapsed time indicator and components which are part of the heater and regulated supplies for rf amplifier subassembly 6AR1A1. The DRIVER metering facility and test points are also included in circuit card assembly 6AR1A2A2. Refer to chapter 3 for troubleshooting procedures and to paragraph 4–85 for replacement procedures.

4–38. Connector-Filter Assembly 6AR1A2A3

a. Test Equipment and Material Required.

Equipment	Common Name
Multimeter TS-352B/U	Multimeter

b. Test Procedure. This assembly comprises plug 6AR1A2A3P1 and associated filter connectors. Check each circuit as follows (fig. 6–14):

(1) Check continuity between each pin and rf connector of 6AR1A2A3P1 and its associated filter connector.

(2) Check for a shortcircuit between e pin of 6AR1A2A3P1 and ground.

c. Repairs.

(1) If tests above indicate that a filter 6AR1A2A3P1 requires replacement, refer to pa graph 4–86.

(2) If one or more of the small connect pins of 6AR1A2A3P1 are broken, rem 6AR1A2A3 and replace 6AR1A2A3P1. Refer paragraph 4–10 for replacement of connectors.

(3) The rf connectors in 6AR1A2A3P1 be replaced as follows:

(*a*) Force the rf connector back into connector-filter assembly.

(*b*) Slide the insulating sleeve back al the cable and unsolder the faulty connector.

(*c*) Install the new connector to the cable (refer to paragraph 4–10).

(*d*) Push the new connector into mounting hole in 6AR1A2A3P1l until the reta ing springs snap into place, holding the conn tor firmly.

4–39. Filter Assembly 6AR1A2A4

a. Test Equipment and Material Required.

Equipment	Common Name
Transmitter Test Facility TS-2866(V)1/ GRM-95(V)	Transmitter test facility
Accessory Kit, Test Facilities Set TS-1173(V)1/ GRM-95(V).	Accessory kit
Generator Sweep Signal AN/USM-203	Sweep generator
Oscilloscope AN/USM-281	Oscilloscope
Insulation Tester Norma 66701	Insulation tester

b. Test Procedure.

NOTE

Remove and replace the module as shown in paragraph 4–87.

(1) *Insulation checks.*

Using the insulation tester check for c tinuity between points listed in table below:

From center conductor of	To	Test Voltage (volts)	Resistance ohms
J3	Chassis	500	500 mego
J3	Center conductor of J2	100	0
J2	FL2	100	0
J1	Chassis	500	500 mego
J1	Center conductor of J4	100	0
J4	FL1	100	0

(2) *Vswr measurements.*

(*a*) Connect the test equipment as shown gure 4-72.

(*b*) Set the sweep generator controls as ws:

ntrol	Position
arker width	1/4 turn from MIN.
F function	SWEEP position
veep width	maximum
evel limit max.	adjust to mid-point
evel limit min.	adjust fully CCW
onitor	RFI position
evel	fully CW
f attenuation	0 DB
weep	200 MHz
larkers	all set to ON and adjusted for suitable amplitude.
ower	set to ON

(*c*) Set the horizontal sweep control of oscilloscope to external and the Y and X in- s to dc.

(*d*) Adjust the vertical controls of the illoscope until the baseline trace is on base- e of the graticule.

(*e*) Adjust the vertical sensitivity con- of the oscilloscope so that the second trace at a convenient level (elg., top of graticule). s second trace represents the 1.4 vswr refer- e line.

(*f*) On the sweep generator, using the lt-in markers as reference, adjust the sweep l until 220 MHz is in the center of the trace.

(*g*) Slowly rotate the sweep dial between MHz and 405 MHz and note variations of trace. Any change should not be greater 1 cm.

NOTE

If the change of the trace is greater than 1 cm, check to see that the sweep generator level control is still in the fully cw position. If the change of level is still excessive, check the vswr of the vswr detector.

(*h*) Draw a horizontal line on the oscillo- pe graticule at the height of the minimum deflection of the trace from the baseline. This is the limit line.

(*i*) Set the two trimmer capacitors on the unit under test to their fully out position.

(*j*) Remove 1.4:1 calibrated mismatch from port Z2 of the vswr detector. Connect connector J1 on the unit under test to port Z2.

(*k*) Connect a 50-ohm matched load to connector J4 on the unit under test.

(*l*) Set the sweep generator sweep dial to 300 MHz.

(*m*) Adjust trimmer capacitor C1 on the unit under test for a minimum deflection of the vertical trace on oscilloscope.

(*n*) Set the sweep generator sweep dial to 220 MHz and readjust C1 if necessary to obtain minimum deflection. Repeat for a setting of 405 MHz.

(*o*) Slowly rotate the sweep generator dial from 220 MHz to 405 MHz. The vswr should remain below the 1.4 reference line over the entire frequency range.

(*p*) On the unit under test, remove the cable from connector J1 and connect it to J3.

(*q*) On the unit under test, disconnect the 50-ohm matched load from connector J4 and connect it to J2.

(*r*) Set the sweep generator sweep dial to 300 MHz and adjust trimmer capacitor C2 on the unit under test for a minimum deflection of the vertical trace on oscilloscope.

(*s*) Repeat this adjustment at 220 MHz and 405 MHz.

(*t*) Slowly rotate the sweep generator dial again between 200 MHz and 450 MHz. Deflection of the oscilloscope trace should be below the limit line of (*h*) above at any point between 220 MHz and 405 MHz.

(*u*) Seal all adjusted controls on the unit under test as described in paragraph 4-12.

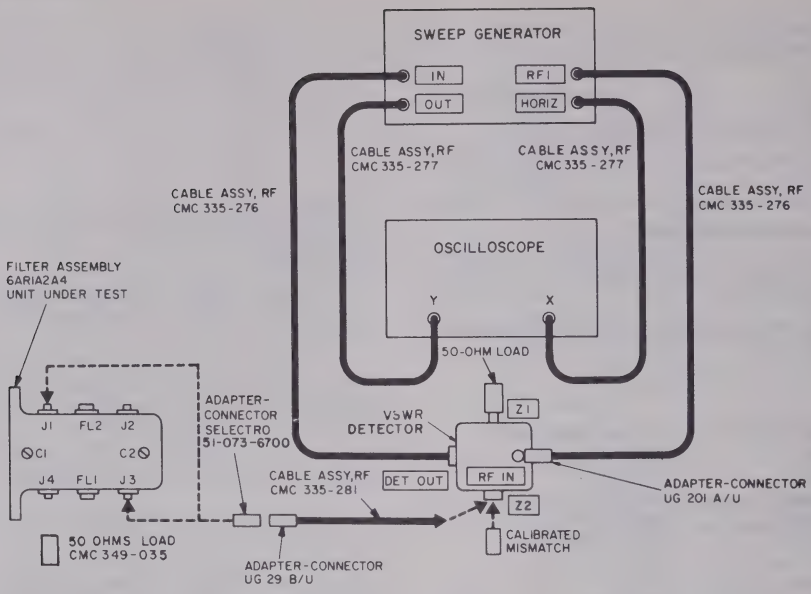


Figure 4-72. Filter assembly 6AR1A2A4 vswr check set-up.

c. Troubleshooting (fig. 2-34 and 4-73).

Symptom	Checks and corrective measures
Center conductor of J3 shorting to chassis.	Check J3 and J2 connectors and repair connectors if necessary.
Center conductor of J1 shorting to chassis.	*a.* Check J1 and J4 connectors; repair connectors if necessary. *b.* Check to see that L1 leads are properly insulated from chassis.
High resistance, J3 to J2.	Check from J3 to J2 for loose connection; resolder if necessary.
High resistance J1 to J4.	Check J1 to J4 for loose connection; resolder if necessary.
High resistance J2 to FL2.	Check for loose or open L2.
High resistance J4 to FL1.	Check for loose or open FL1.

4-40. Receiver Radio 1RE1 (Receiver Fixed Head)

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Receiver TS-2867(V)1/GRM-95(V)	Reveiver test facility
Accessory Kit, Test Facilities Set	Accessory kit
Generator, Signal AN/USM-44A	Signal generator
Voltmeter, Electronic ME-30A/U	VTVM
Oscilloscope AN/USM-140	Oscilloscope
Generator, Signal AN/USM-205	Wide range oscillator
Selective Voltmeter AN/USM-306	Level meter
Wattmeter AN/URM-98	Power meter
Counter, Electronic Digital Readout AN/USM-207	Counter
Analyzer, Distortion HP-331A	Distortion analyzer

b. Test Procedure.

(1) *Operational check.*

(*a*) Connect equipment as shown in figure 4-74.

(*b*) Set the test facility switches as follows:

Switch	Position
S1	ON
S5	S10
S10	-12V

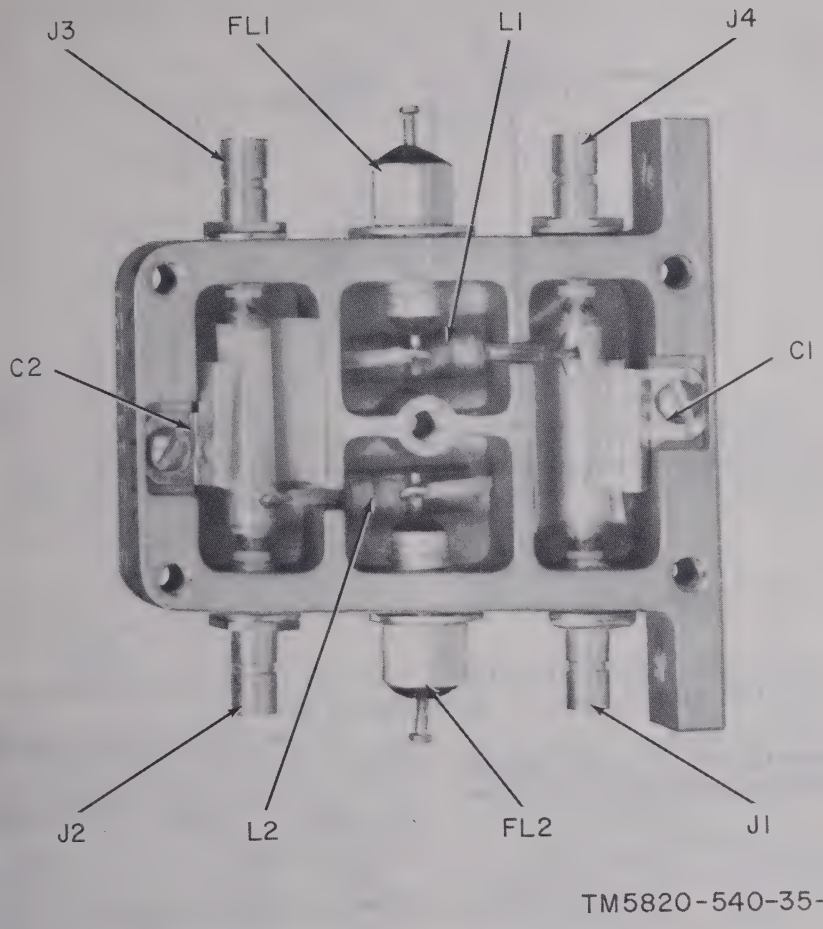


Figure 4-73. Filter assembly 6AR1A2A4, parts location.

(c) On the unit under test set BUZZER OFF-ALARMS NORMAL switch S3 to ALARMS NORMAL position, and the AC POWER switch to ON. Observe the unit under test for the following indications:

1. AC POWER lamp lights.

2. SYNC lamp lights.

3. LOW SIGNAL lamp may light.

(d) If the buzzer does not sound, press the BUZZER OFF button and the buzzer should sound.

(e) Set BUZZER OFF-ALARMS NORMAL switch S3 on unit under test to BUZZER OFF position. Buzzer should silence, and alarm lamps should dim.

(f) Set BUZZER OFF-ALARMS NORMAL switch S3 on unit under test to ALARMS NORMAL. Buzzer should sound and alarm lamps should brighten.

(g) Press the BUZZER OFF button on the button on the unit under test to silence the buzzer.

(h) Set test facility switch S8 to 47.50. The SYNC lamp should go out on unit under test.

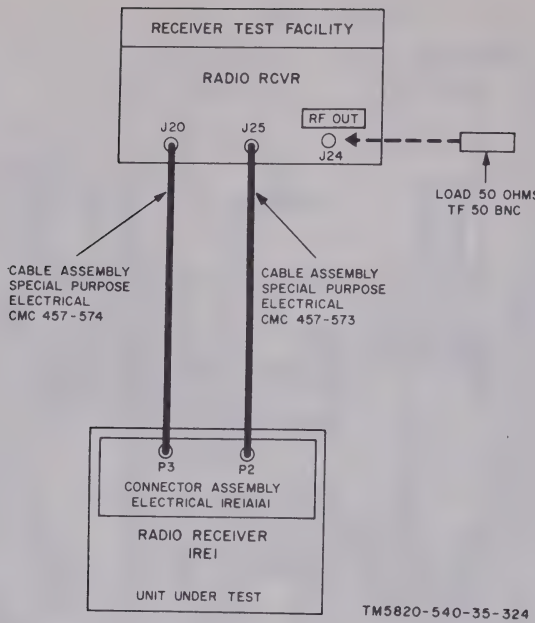


Figure 4-74. Receiver fixed head, operational check, test set-up.

(*i*) Press test facility HIGH SIG ALM switch S11. The HIGH SIGNAL lamp on the unit under test should light.

(*j*) Observe the indications at all positions of the meter switch on the unit under test as follows:

Switch position	Indication
+12V	Green band
-12V	Green band
REFL PWR	Zero
XMTR DUPL	Zero
OSC	Between 20% and 90% of full scale.
DOUBLER	Between 20% and 90% of full scale.
MULT	Zero
RCVR SIG	May be zero or a positive indication; should not exceed 40% of full scale.
12 CH PCM	Positive indication due to receiver noise.
24 CH PCM	Positive indication due to receiver noise.
FDM	Positive indication due to receiver noise.
OW	Positive indication due to receiver noise.

(2) *Video level, metering, and wideband noise check.*

(*a*) Connect the equipment as shown in figure 4–75A.

(*b*) Set the test facility switches as follows:

Switch	Position	Normal indication
AT1	20 DB	
S5	S9	
S9	1 KHZ	
S8	47.5	
S10	-12V	Meter M1 should indicate in green band

(*c*) Set test facility switch S9 to 300 kHz. The LOW SIGNAL lamp on the unit under test should go out. The VTVM should indicate **315 mv ±45 MV.**

(*d*) Set the meter switch on the unit under test to 24 CH PCM. The meter on the unit under test should indicate in the green band.

(*e*) Set test facility switch S9 to 100 kHz. The VTVM should indicate 159 mv ±16 mv.

(*f*) Set the meter switch on the unit under test to 12 CH PCM.

(*g*) Transfer the VTVM to J21 of the test facility (fig. 4–75B) and terminate the VTVM with 91 ohms.

(*h*) Set test facility switch S9 to 75 kHz. The VTVM should indicate 190 mv ±20 mv.

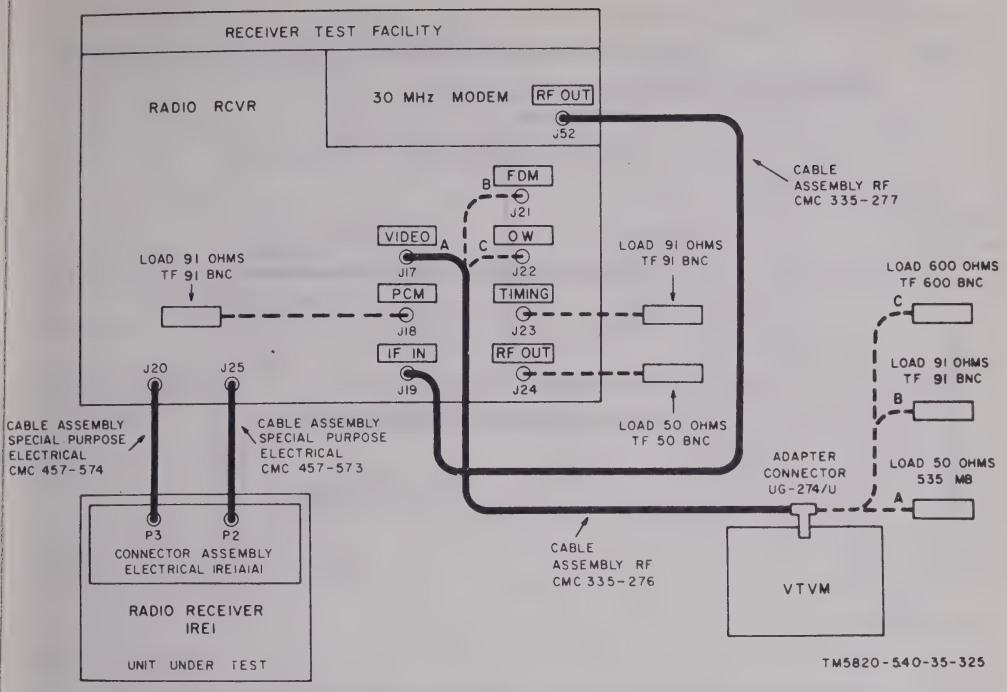


Figure 4-75. Receiver fixed head, video level, metering, and wideband noise check, test set-up.

(*i*) Set the meter switch on the unit under test to FDM. The meter on the unit under test should indicate in the green band.

(*j*) Transfer the VTVM to J22 of the test facility (fig. 4–75C) and terminate the VTVM with 600 ohms.

(*k*) Set test facility switch S9 to 45 kHz The VTVM should indicate 245 mv ± 45 mv.

(*l*) Set the meter switch on the unit under test to OW. The meter on the unit under test should indicate in the green band.

(3) *Wideband noise check.*

(*a*) Connect the VTVM to J17 of the test facility (fig. 4–75A).

(*b*) Disconnect the cable at J19 of the test facility. The VTVM should indicate **-20 dbm** 5 dbm.

(4) *Pcm regeneration and timing checks.*

(*a*) Connect the equipment as shown in figure 4–76.

(*b*) Set the wide range oscillator to 10 kHz and turn the output control fully counterclockwise.

(*c*) Observe the timing pulses displayed on the oscilloscope. The pulse train should be 2 volts ±0.2 volts peak-to-peak with a pulse width, at 50 percent amplitude, of between 80 and 150 manoseconds.

(*d*) Interchange the test facility connections at J18 and J23.

(*e*) Set test facility switch S9 to the 180 KHZ position and record the level indicated on the VTVM.

(*f*) Set switch S9 to the EXT VIDEO position.

(*g*) Adjust the output of the wide range oscillator until the VTVM indicates the level that was recorded in (*e*) above.

(*h*) Set the meter switch on the unit under test to 12 CH PCM. The meter should indicate in the green band.

(*i*) Vary the output level of the wide range oscillator by +3 and –3 db as indicated on the wide range oscillator meter. The pcm train displayed on the oscilloscope should not change. The meter indication on the unit under test should not change.

(*j*) Remove the 91 ohm load from the oscilloscope. The oscilloscope display should disappear and the meter indication on the unit under test should be almost zero. Replace the 91ohm load at the oscilloscope.

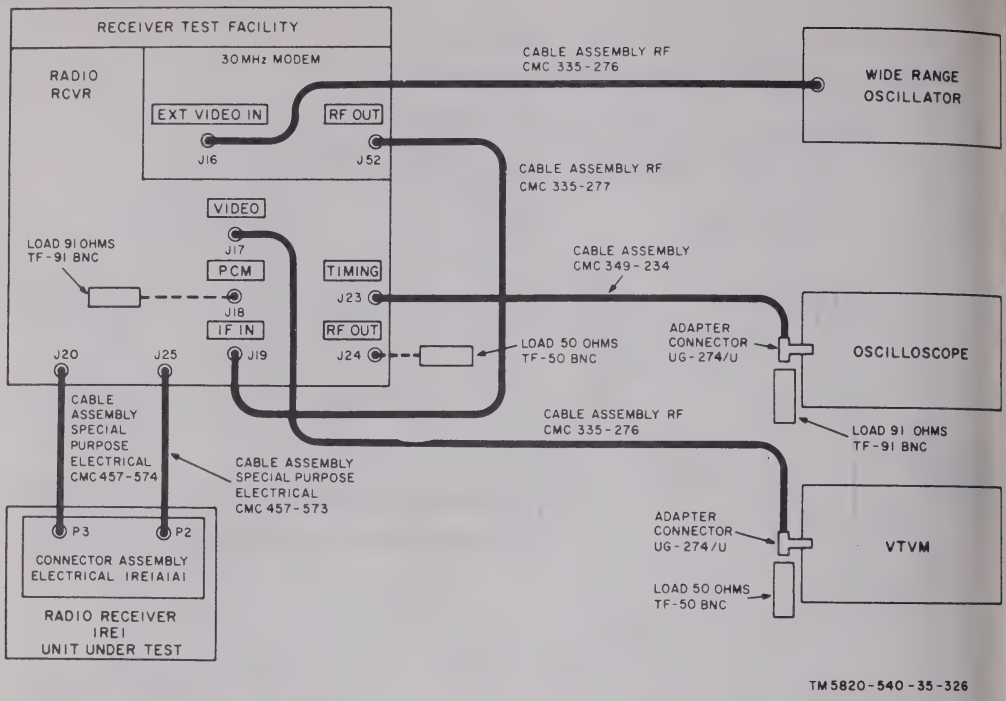


Figure 4-76. Receiver fixed head, pcm regeneration, timing, and pcm squelch check, test set-up.

(5) *Pcm squelch.*

(*a*) Set test facility switch AT1 to 40 DB and S9 to 180 KHZ. Note the VTVM indication.

(*b*) On the test facility, set S9 to EXT VIDEO.

(*c*) Set the wide range oscillator to 10 kHz and adjust the output level until the VTVM indicates the same as noted in (*a*) above.

(*d*) Increase the frequency from the wide range oscillator until the pcm pulse train displayed on the oscilloscope disappears. The oscillator frequency should now be between 450 kHz and 600 kHz.

(6) *Receiver squelch.*

(*a*) Connect the equipment as shown in figure 4–77.

(*b*) Set the test facility switches as follows:

Switch	Position
S9	30 MHZ
S14	30 MHZ
S8	47.5

(*c*) Using AT1 on the test facility, and the external variable attenuators, increase the attenuation until the LOW SIGNAL lamp ligh and the buzzer sounds on the unit under tes The VTVM indication should be between –20 dbm and –22.6 dbm.

(*d*) Decrease the attenuation until th alarm clears. The VTVM indication should be n more than 2 db higher than the indicatio obtained in (*c*) above.

NOTE

Due to variations in the gain of the if. amplifiers, the required baseband noise level to operate the squelch may not be reached. In this case, check the squelch circuits as follows:

1. Connect the equipment as shown i figure 4–77.

2. Set the wide range oscillator to 60 KHZ and turn the output level control fully counterclockwise.

3. Adjust the variable attenuators fo an indication of 5 mv or less on the VTVM.

4. Set test facility switch S9 to EXT VIDEO.

5. Slowly increase the output level o the wide range oscillator until the LOW SIG lamp

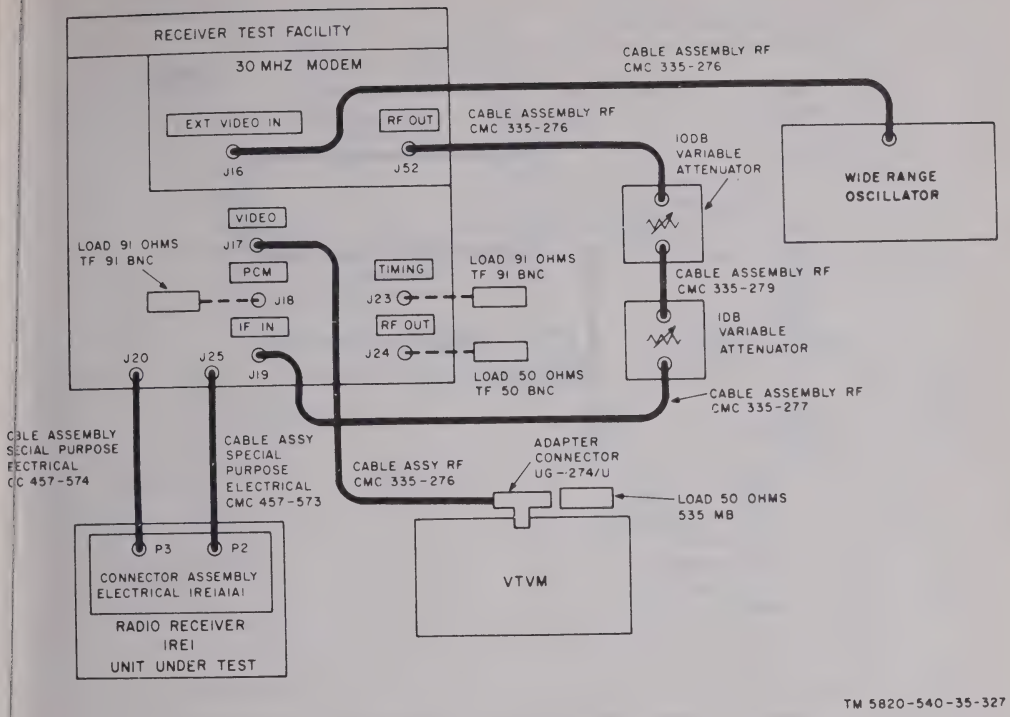


Figure 4-77. Receiver fixed head, receiver squelch check, test set-up.

ligts and the buzzer sounds on the unit under tes. The VTVM should indicate between 26 mv an 34 mv.

6. Decrease the output of the wide rage oscillator until the LOW SIG lamp goes ou and the buzzer silences on the unit under tes. This decrease in level from the wide range os llator should not exceed 2 db.

(7) *Receiver signal monitor check.*

(*a*) Connect equipment as shown in figure 4–8.

(*b*) Set the test facility switches as foows:

Switch	Position
S9	30 MHZ
AT1	20 DB
S8	47.5

(*c*) Set the meter switch on the unit under tt to REC SIG.

(*d*) On the unit under test, set the RCVR SG ADJUSTMENT (right hand side panel) f ly clockwise.

(*e*) Set the variable attenuators to 1 db. The meter on the unit under test should indicate approximately 80% of full scale deflection.

(*f*) Slightly adjust the RCVR SIG METER ZERO on video amplifier 1RE1AR1 of the unit under test to obtain a meter indication of 80% of full scale deflection.

(*g*) Set AT1 on the test facility to 70 db. The meter on the unit under test should indicate a low reading.

(*h*) Final adjustments are made during the system test. Refer to paragraph 4–74.

(8) *Video return loss measurement.*

(*a*) Connect the equipment as shown in figure 4–79A.

(*b*) Set the test facility switches as follows:

Switch	Position
S9	EXT VIDEO
AT1	30 DB
S14	30 MHZ
S8	47.5

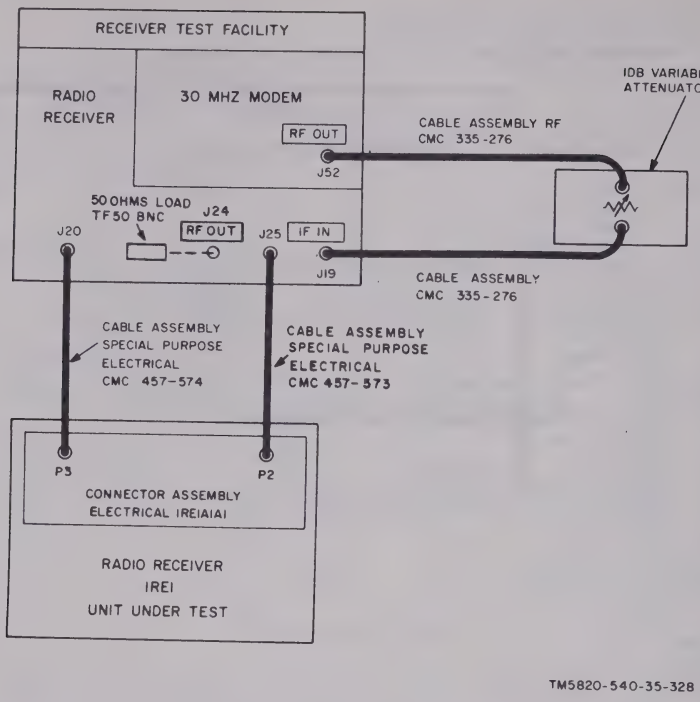


Figure 4-78. Receiver fixed head, receiver signal monitor check, test set up.

(*c*) Set the wide range oscillator to 1.0 kHz ± 100 Hz and adjust the output level until the VTVM indicates –14 dbm.

(*d*) Connect the equipment as shown in figure 4–79B. The VTVM should indicate less than –26 dbm.

(*e*) Repeat (*a*) through (*d*) above for frequencies of 10 kHz, 100 kHz, 500 kHz and 1 MHz (all frequencies ±10 percent).

(9) *Rf output power level and frequency generation check.*

(*a*) Connect the equipment as shown in figure 4–80A.

(*b*) For all positions of test facility switch S8, the output power indicated on the power meter should not be less than +4 dbm.

(*c*) Connect the equipment as shown in figure 4–80B.

(*d*) For all positions of test facility switch S8, the output frequency indicated on the counter should be as follows:

Switch S8 position	Frequency
47.50	95.00000 ±0.001%
48.33	96.66666 ±0.001%
50.65	101.31300 ±0.001%
52.31	104.62500 ±0.001%
54.98	109.95832 ±0.001%
58.25	116.50000 ±0.001%
61.66	123.33333 ±0.001%
63.46	126.93750 ±0.001%
66.00	132.00000 ±0.001%
67.50	135.00000 ±0.001%
72.50	145.00000 ±0.001%

(10) *Video frequency response check.*

(*a*) *Initial calibration.*

1. Connect the test equipment as shown in figure 4–81A.

2. Set the test facility switches as follows:

Switch	Position
S9	EXT VIDEO
S14	30 MHZ
AT1	30 DB
S10	–12V
S8	47.5

3. Set the coaxial switch to position

4. Set the wide range oscillator frequency to 10 kHz.

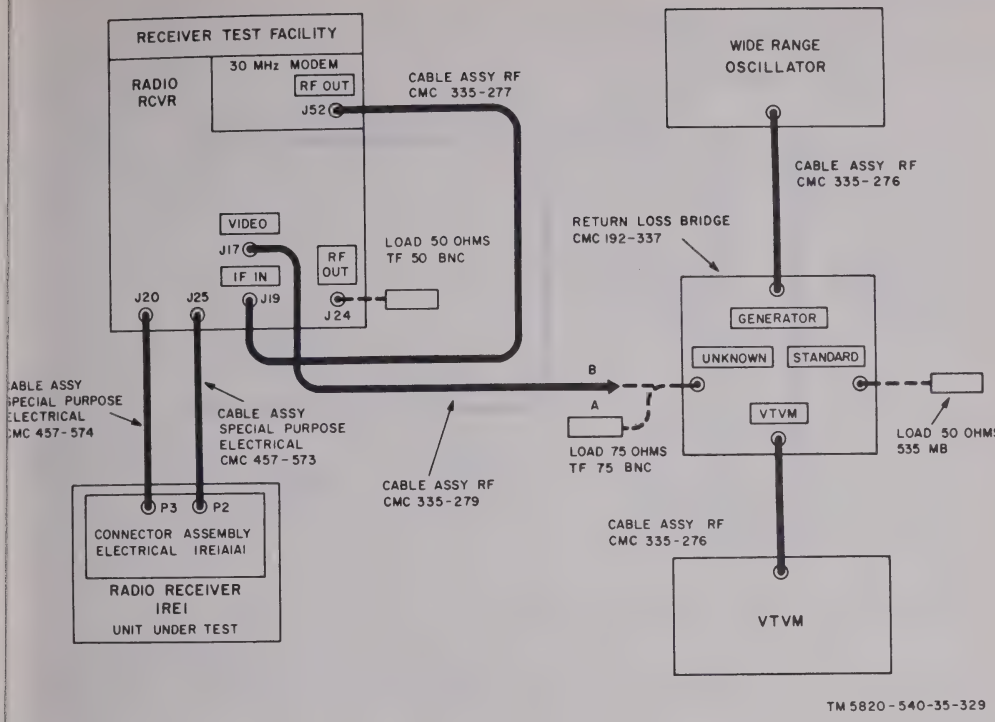


Figure 4-79. Receiver fixed head, video return loss measurement, test set-up.

5. Set the meter switch on the unit under test to FDM.

6. For frequencies below 10 KHz replace the level meter with distortion analyzer HP 331A (fig 4-81B).

7. Check the signal-to-noise ratio as follows:

(a) Set the wide range oscillator to 60 kHz.

(b) Set the frequency of the level meter to 960 kHz and record the indication.

(c) Disconnect the wide range oscillator and increase the level meter gain by 20 db. The level meter indication should not exceed the indication obtained in (b) above (signal-to-noise ratio of at least 20 db).

(*b*) *Tests.*

1. Set the wide range oscillator to 10 kHz.

2. Set the frequency of the level meter to 10 kHz and record the indication.

3. Set the coaxial switch to position 1.

4. Adjust the variable attenuators to obtain an indication within 0.1 db of the indication obtained in 2 above. Record the variable attenuator setting. This is the 10-kHz reference level.

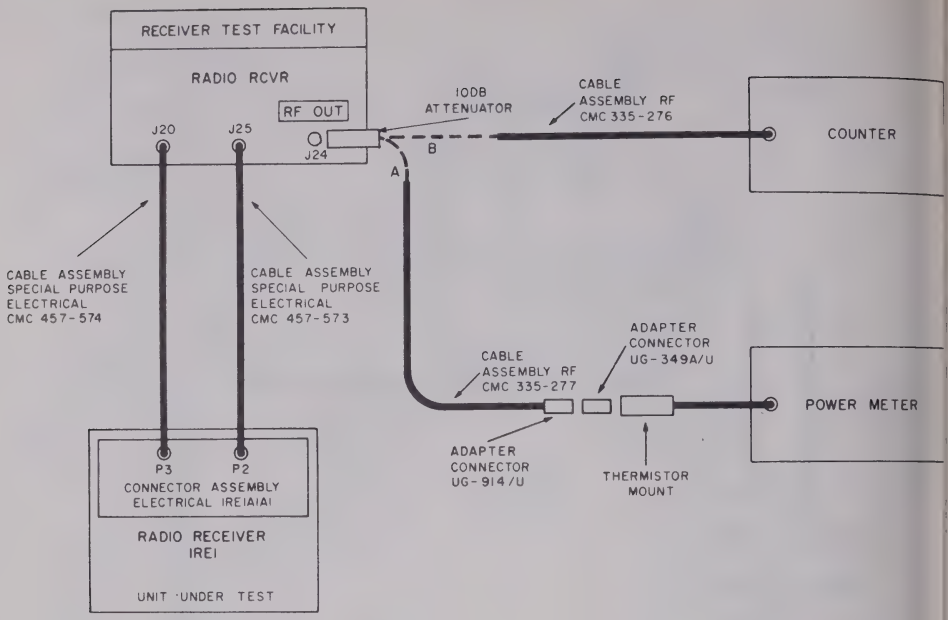
5. Repeat 1 through 4 above for all modulating frequencies above 10 kHz listed in the chart below. The relative attenuation should be within the corresponding limits shown. Record the indications.

6. For frequencies below 10 kHz replace the level meter with the distortion analyzer (fig. 4-81B).

7. Replace the 20 db fixed attenuator at J16 of the test facility with the 10 db fixed attenuator (fig. 4-81B).

8. Complete the checks for the remaining frequencies listed below.

Modulating frequency (kHz)	Relative attenuation (db)—reference attenuation 10 kHz		
	Nominal	Minimum	Maximum
0.125	1.0	0.5	1.5
0.200	0.5	0	1.1
0.250	0.2	0	1.1
1.0	0	-0.1	0.1
10.0	0	-0.1	0.1
30.0	0	-0.1	0.1
60.0	0.15	0.05	0.25



TM5820-540-35-330

Figure 4-80. Receiver fixed head, synthesizer output level and frequency generation check, test set-up.

Modulating frequency (kHz)	Relative attenuation (db)—reference attenuation 10 kHz		
	Nominal	Minimum	Maximum
120.0	0.6	0.5	0.7
180.0	1.3	1.1	1.5
240.0	2.3	2.0	2.6
360.0	5.1	4.6	5.6
480.0	9.0	8.2	9.8
600.0	14.0	12.8	15.2
720.0	20.2	18.4	22.0
840.0	27.5	25.3	29.7
960.0	36.0	33.0	39.0

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4–41. Monitor Panel 1RE1A1

Monitor panel 1RE1R1 includes electrical connector assembly 1RE1A1A1, alarm control 1RE1A1A2, circuit card assembly 1RE1A1A3, and the front panel switches, controls, alarms, and indicators. Refer to paragraph 4–40 for a complete operational check of the monitor panel 1RE1A1.

4–42. Electrical Connector Assembly 1RE1A1A1

Electrical connector assembly 1RE1A1A1 includes the wiring harness and associated connectors of monitor panel 1RE1A1. Check electrical connector 1RE1A1A1 when troubleshooting procedures in paragraph 4–40 indicate defective wiring.

a. Test Equipment and Material Required.

Equipment	Common Name
Multimeter TS-352B/U	Multimeter

b. Test Procedure. Refer to the receiver interconnecting diagram (fig. 6–29) and check the continuity between the associated connector pins. Refer to paragraph 4–10 for repair and/or replacement of cables and connectors.

4–43. Alarm Control 1RE1A1A2

Alarm control 1RE1A1A2 is identical to alarm control 5TR1A1A2. Refer to paragraph 4–18 for testing and troubleshooting procedures.

4–44. Circuit Card Assembly 1RE1A1A3

a. Test Equipment and Material Required.
b. Test Procedure.

Equipment	Common Name
Multimeter TS-352B/U	Multimeter

(1) Using the multimeter, measure the forward and reverse resistances of diode CR1 across pins E2 and E3 (fig. 4–83).

(2) Check 20k resistor R1 by connecting the multimeter across pins E1 and E3 (fig. 4–8). Vary R1 through its range to check for intermittent contacts.

4–45. Electrical Frequency Synthesizer 1RE1A2

Electrical frequency synthesizer 1RE1A2 is identical to electrical frequency synthesizer 5TR1A2 and is tested with the transmitter test facility. Refer to paragraph 4–19 for testing and troubleshooting procedures.

4–46. Pulse Form Restorer 1RE1A3

a. Test Equipment and Material Required.

Equipment	Common Name
Receiver, Test Facility TS-2867(V)1/GRM-95(V)	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V)	Accessory kit
Oscilloscope AN/USM-281 complete with vertical and horizontal units	Oscilloscope
Counter, Electronic, Digital Readout AN/USM-207	Counter
Generator, Signal AN/USM-205	Wide range oscillator
Voltmeter, Electronic ME-30A/U	VTVM
Multimeter TS-352B/U	Multimeter

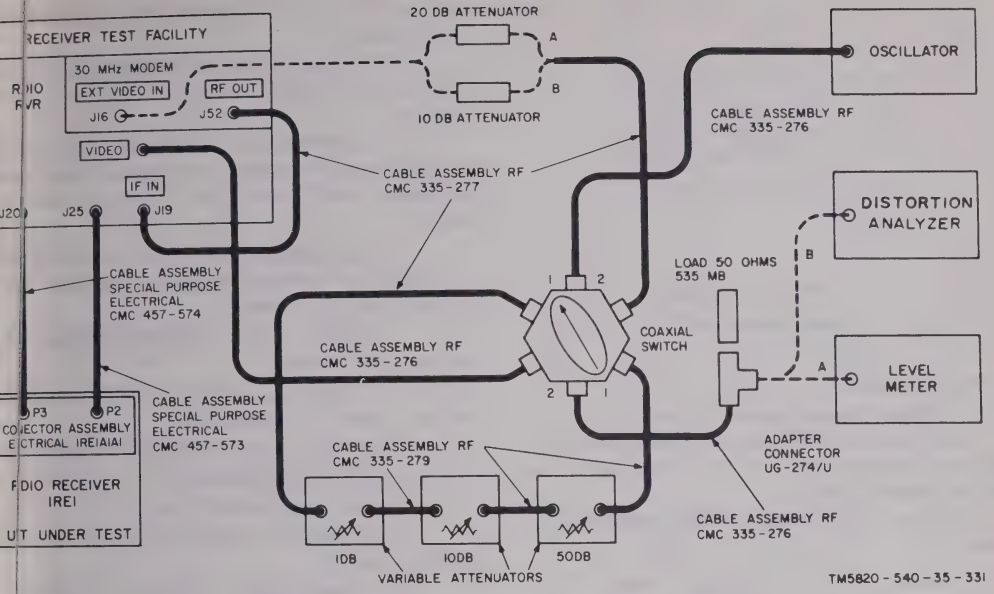


Figure 4-81. Receiver fixed head, video frequency response, test set-up.

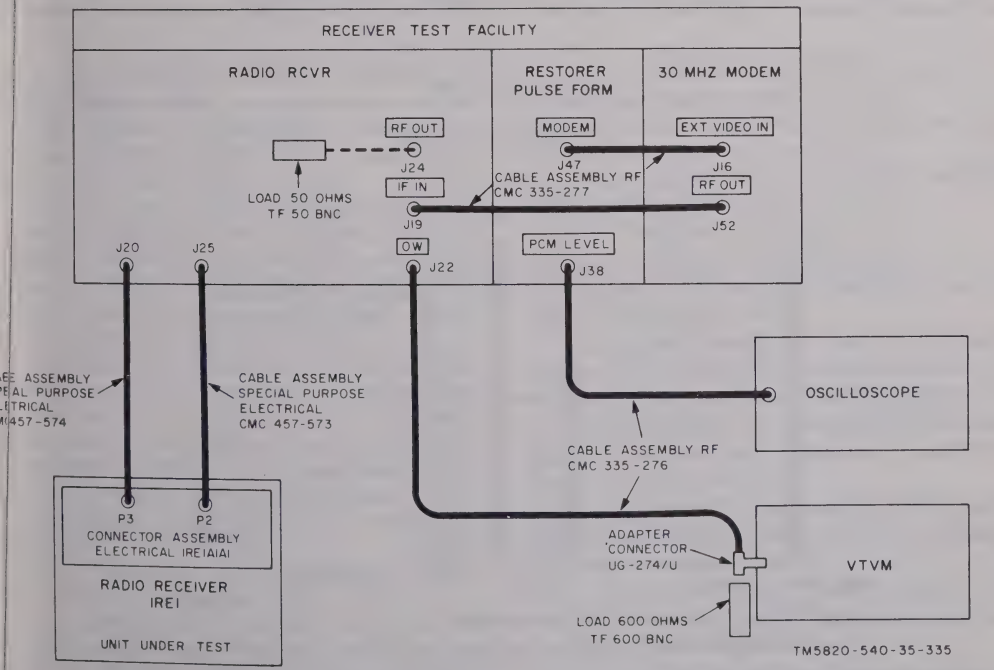


Figure 4-82. Receiver fixed head, order wire signal-to-noise ratio measurement, test set-up.

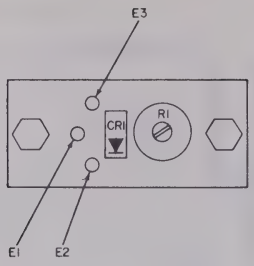


Figure 4-83. Circuit card assembly 1RE1A1A3, parts location.

b. Test Procedure.

(1) *Timing pulse generator check.*

(*a*) Remove both covers from the unit under test and connect the test equipment as shown in figure 4–84A.

(*b*) Set the test facility switches as follows:

Switch	Position
S5	S15
S15	PCM & TMG
S1	ON

(*c*) Observe the waveform displayed on the oscilloscope channel B (fig. 4–85A), and adjust the PCM LEVEL control for a 1.5v peak-to-peak display.

(*d*) Adjust the test facility FREQ control for 576.000 kHz, as indicated on the counter.

(*e*) Observe the waveform displayed on the oscilloscope channel A; it should be as shown in figure 4–85B, with the following characteristics:

1. 2v peak-to-peak ±10 percent measured from the average baseline to the peak. Ignore a small pip, if present.

2. 80 to 150 nanosecond pulse width at the 1-volt point.

3. Rise time (10% to 90% amplitude) of less than 70 nanoseconds.

4. Fall time (10% to 90% amplitude) of less than 70 nanoseconds.

(2) *Pcm regenerator check.*

(*a*) Connect the test equipment as shown in figure 4–84B.

(*b*) Observe the waveform displayed on the oscilloscope channel A; it should be as shown in figure 4–85C.

(*c*) Connect the oscilloscope probe to the oscilloscope channel A and monitor test point TP1 on the 1RE1A3A3 printed circuit board fig.

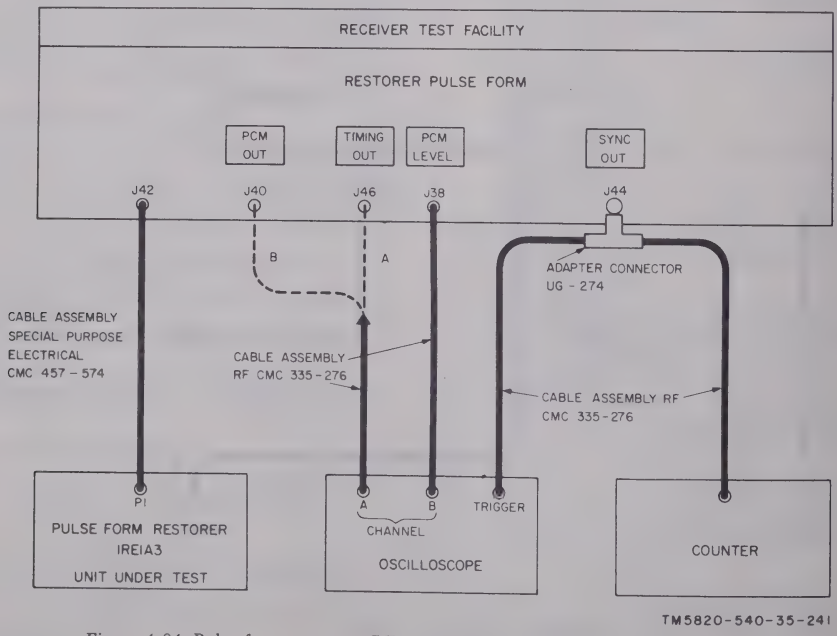


Figure 4-84. Pulse form restorer 1RE1A3, timing pulse check, test set-up.

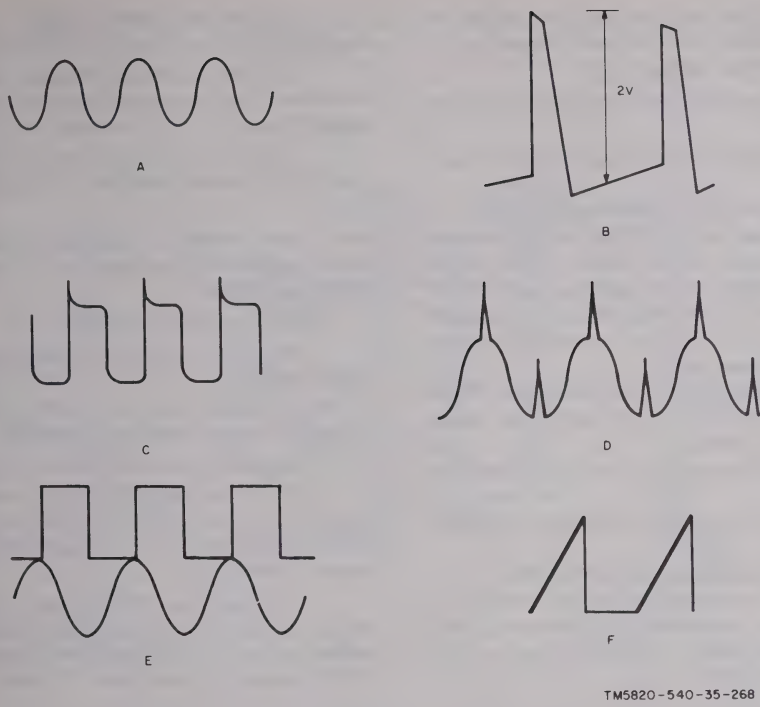


Figure 4-85. Pulse form restorer 1RE1A3 waveform displays.

–8C). The oscilloscope display should be as hown in figure 4–85F.

(*d*) Connect the oscilloscope channel A o he test facility TIMING OUT connector J46 s shown in figure 4–84A.

(*e*) Set the oscilloscope to algebraic add n adjust channels A and B display controls o btain a waveform as shown in figure 4–85D. Th leading edge of the timing pulse should be o tioned 0.25 microsecond to the right of the e of the pcm pulse (sinewave).

(*f*) Adjust the test facility FREQ ADJ co rol so that the frequency of the timing pulse s aried between 575.975 kHz and 576.025 kHz as indicated on the counter. Check to see that th waveform display on the oscilloscope re- ns synchronized to the timing pulses.

(*g*) Reset the FREQ ADJ control to 57 .000 kHz.

(*h*) Reconnect the oscilloscope channel A to PCM OUT connector J40.

(*i*) Observe the waveform displayed on th oscilloscope channel A; it should be as sh wn in figure 4–85C with the following cl racteristics:

1. Negative-going square wave at 2v peak-to-peak ±10 percent.

2. Rise time (10% to 90% amplitude) between 20 and 50 nanoseconds.

3. Fall time (10% to 90% amplitude) between 20 and 50 nanoseconds.

(3) *Pcm metering check.*

(*a*) With the test equipment set up as in (2) above, test facility meter M1 should indicate in the green band.

(*b*) Momentarily set test facility switch S16 to TEST; meter M1 should indicate zero and the display on oscilloscope should disappear.

(*c*) Set the oscilloscope for "alternate" display; the waveform displayed should be as shown in figure 4–85E.

(*d*) Vary the test facility PCM LEVEL control between 1.2v and 1.75v. The regenerated pcm should remain constant.

(*e*) Adjust the test facility PCM LEVEL control to reduce the display on channel B to 0.4v peak-to-peak.

(*f*) Check to see that the regenerated pcm pulses displayed on channel A disappear and

meter M1 indicates zero when the display on channel B is reduced to 0.4v peak-to-peak.

(4) *Order wire noise test.*

(*a*) Connect the test equipment as shown in figure 4–86.

(*b*) Set switch S15 to the OUTPUT position.

(*c*) Observe the oscilloscope channel A and adjust the test facility PCM LEVEL control for a 1.5v peak-to-peak display. The PCM LEVEL must remain at this setting for test (5) below. Note the VTVM indication; it should be −16 dbm. The test facility meter M1 should indicate in the green band.

(*d*) Set switch S15 to NOISE; the VTVM should indicate at least 32 db below the indication noted in (*c*) above.

(5) *Order wire gain and frequency response test.*

(*a*) Connect the test equipment as shown in figure 4–87.

(*b*) Set switch S15 to **RESPONSE.**

(*c*) Set the coaxial switch to position 1. Adjust the wide range oscillator frequency to 1 kHz at an output level of 130 mv rms as indicated on the VTVM.

(*d*) Set the coaxial switch to positio the VTVM should indicate −10 dbm.

(*e*) Set the coaxial switch to position 1 tune the wide range oscillator to 200 Hz a output level of 130 mv rms.

(*f*) Set the coaxial switch to positio the VTVM should indicate −10 dbm +1 d db.

(*g*) Repeat (*e*) and (*f*) above with wide range oscillator tuned to 250 Hz, 1.5 2 kHz and 3 kHz.

(6) *Order wire distortion test.*

(*a*) Connect the test equipment as sh in figure 4–88A.

(*b*) Rotate the test facility PCM LE control fully ccw (minimum position).

(*c*) Set switch S15 to DISTORTIO

(*d*) Tune the wide range oscillator quency to 1 kHz and adjust the output lev 375 mv peak-to-peak as indicated on the os scope channel A.

(*e*) Vary the wide range oscillator quency adjustment slightly for a minimum cation on the VTVM. The level indicated o VTVM should be less than −35 dbm.

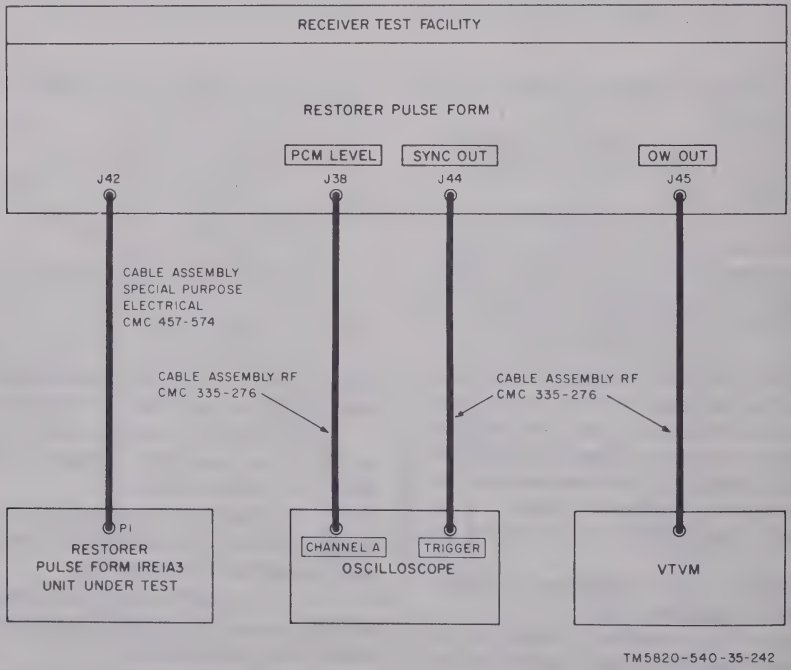


Figure 4-86. Pulse form restorer 1RE1A3 order wire noise check.

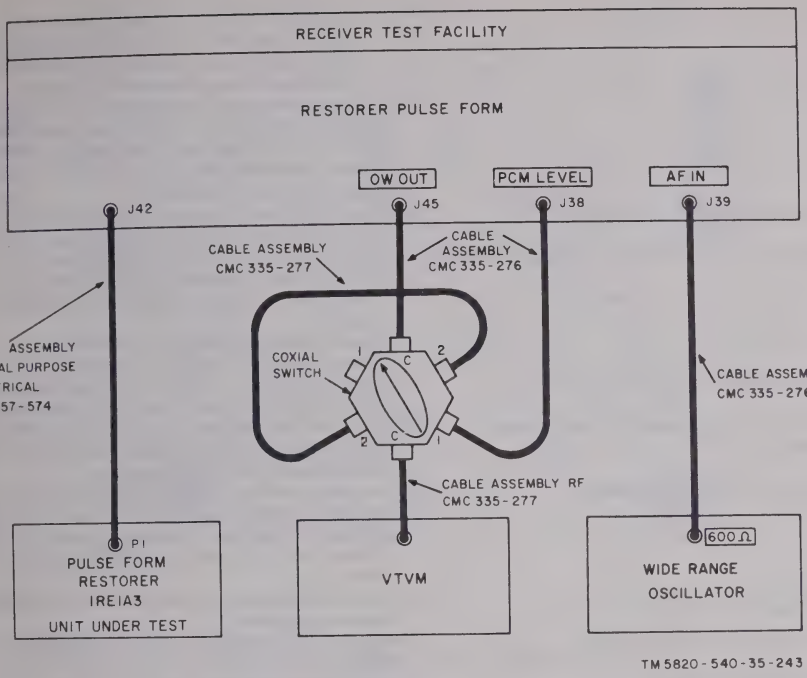


Figure 4-87. Pulse form restorer 1RE1A3, order wire gain and frequency response check, test set-up.

7) *Order wire relay and combiner routing*

(*a*) Set test facility switch S15 to RESE.

(*b*) Connect the test equipment as shown figure 4–88B. (The oscilloscope is not used in st.)

(*c*) Tune the wide range oscillator frey to 1 kHz and adjust the output level to obtain a –4 dbm indication on the VTVM.

(*d*) Connect the test equipment as shown in figure 4–88A.

(*e*) Push and hold test facility switch S16 at TEST; the VTVM should indicate –10 dbm.

(*f*) Release S16 and set S15 to OFF.

c. Troubleshooting (fig. 6–26).

Symptom	Checks and corrective measures
No timing pulse indication; no regenerated pcm indication.	*a.* Check the –12v dc supply at E6 and E12 of 1RE1A3A1 (fig. 4-89). If indication at E6 is normal but abnormal at E12, check L6 (1RE1A3A1) for open circuit. *b.* Check the +12v dc supply at E11 and E1 of 1RE1A3A1. If indication at E1 is abnormal, check L7 (1RE1A3A1) for open circuit. *c.* Set oscilloscope to internal sync; if timing pulse display appears, isolate defective stage in pcm signal path by observing waveforms as follows: (1) Check waveforms at E5 and E6 of 1RE1A3A3 (fig. 4-90) as shown in *e* below. If indications are abnormal, check waveforms at Q1 through Q5 (1RE1A3A3). Check resistances in isolated stage as described in *f* below. (2) If indications at E5 and E6 above are normal, check waveforms at Q6 through Q9 and at TP1 (1RE1A3A3), and measure voltages at

Symptom	Checks and corrective measures
	E10 (4v) (1RE1A3A3), and Q10 collector (3.5v) and Q11 emitter (3v) of 1RE1A3A2 (fig. 4-91 and 4-92). Check resistances of components in isolated stage as described in *f* below.
	d. Set the oscilloscope to internal sync; if no timing pulses are obtained on oscilloscope; check waveforms at Q6 through Q9 (1RE1A3A2) as shown in *e* below. Check resistances of components in isolated stage as described in *f* below.
Timing pulse indicates narrow pulse width.	Observe waveforms at Q6 and Q7 (1RE1A3A2), as shown *e* below. Replace defective resistor as required.
Regenerated pcm waveform abnormal; timing pulse normal.	*a.* Check waveforms at Q2, Q5, Q3, Q4, and Q1 (1RE1A3A2, as shown in *e* below. Measure resistances of components in isolated stage (*f* below).
	b. If regenerated pcm jittering is observed adjust R26 (1RE1A3A3) (fig. 4-90) to reduce jitter.
Low amplitude regenerated pcm waveform.	Check waveforms at Q1 (1RE1A3A2) and check resistor (1RE1A3A2). Replace component as required.
Sawtooth waveform leading edge blurred excessively (*b*(2)(*c*) above).	Adjust R13 (1RE1A3A3) to minimize the width of the b If R13 adjustment is ineffective check CR3 and CR4 (1RE1A3A3). Replace if necessary.
Timing pulse jittering under test (*b*(2)(*f*) above).	Check voltage at Q10 collector (1RE1A3A2); it should b 3.5v dc; if normal, check L3 (1RE1A3A2). Replace if necessary. If indication abnormal, check Q10 (TP1 1RE1A3A3), Q10 and Q11 (1RE1A3A2) as shown in below.
No meter indication (*b*(3)(*a*) above).	Check metering circuit diodes CR1 and CR2 (1RE1A3A3 replace as required.
Abnormal indication test (*b*(3)(*b*) above).	Check Q5 (1RE1A3A1) resistances as described in *f* below.
High noise level (*b*(4)(*d*) above).	Repeat test described in *b*(4)(*a*) thru (*c*) and adjust R11 (PCM CANCEL) and R24 (OW NOISE) on 1RE1A3A1, for a minimum reading on VTVM. If noise level is still high, check waveforms at TP1, Q3, and Q4; check CR1, CR2, and resistanc of Q3 and Q4 as shown in f below.
No order wire output, test facility meter reads zero.	*a.* Check waveform at midpoint of R11 (1RE1A3A1). If normal, check waveform at TP3; check resistances of Q6 and replace if necessary. If TP3 indication normal, check L5 for open circuit; replace if necessary.
	b. If indication at R11 above is abnormal, check the waveform at Q1 and Q2 of 1RE1A3A1 (*e* below). Check resistances of components in isolated stage as shown in *f* below.
Order wire output normal; no meter indication.	Check order wire signal through amplifier Q7 (1RE1A3 and resistances of CR3 and CR4 (RE1A3A1). Replace components as required.
Order wire meter indication normal; no order wire output.	Check relay K1 (fig. 4-93) contacts for open circuit; replace if necessary.
High distortion of order wire signal (*b*(6)(*e*) above).	Check CR1, CR2, and Q6 (1RE1A3A1); replace compon as required.
Order wire relay operation defective (*b*(7)(*d*) above).	Check operation of relay K1, replace if necessary.

d. Adjustments.

(1) *PCM SYNC control R26 (1RE1A3A3).*

(*a*) Connect the test equipment as shown in figure 4–84B, and observe the waveform displayed on the oscilloscope channel A (fig. 4–85C).

(*b*) If the regenerated pcm wavefo jittery, adjust R26 PCM SYNC (1RE1A3A minimize or eliminate the jitter.

(*c*) Adjust SLICER LEVEL contro ((2) below) before the final adjustment of

(*d*) Connect the oscilloscope probe t oscilloscope channel A and monitor test

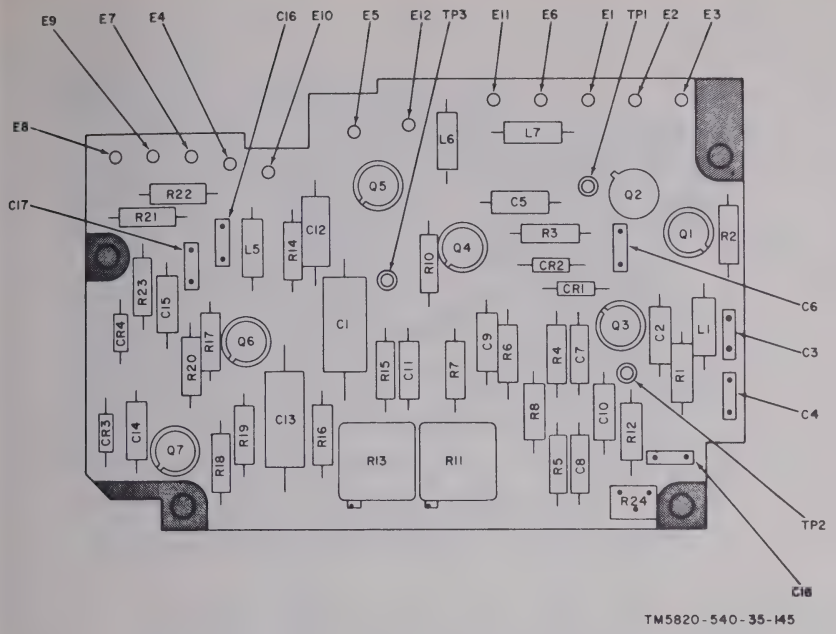


Figure 4-89. Modulation eliminator 1RE1A3A1, parts location.

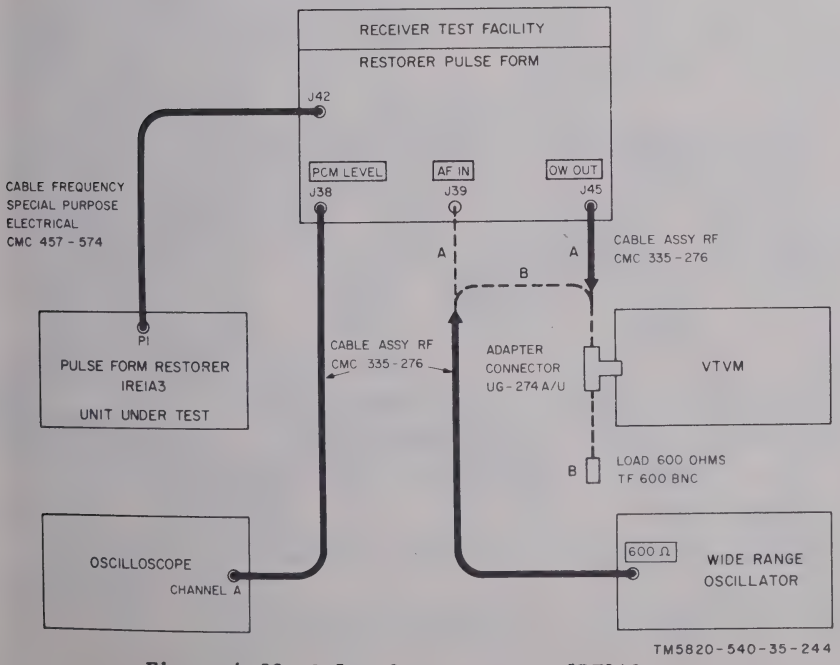


Figure 4-88. Pulse form restorer 1RE1A3, order wire distortion check, test set-up.

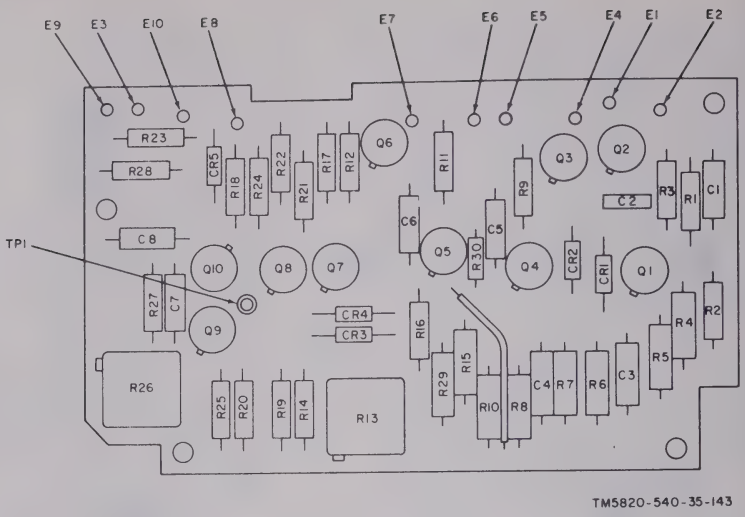


Figure 4-90. Electrical synchronizer 1RE1A3A3, parts location.

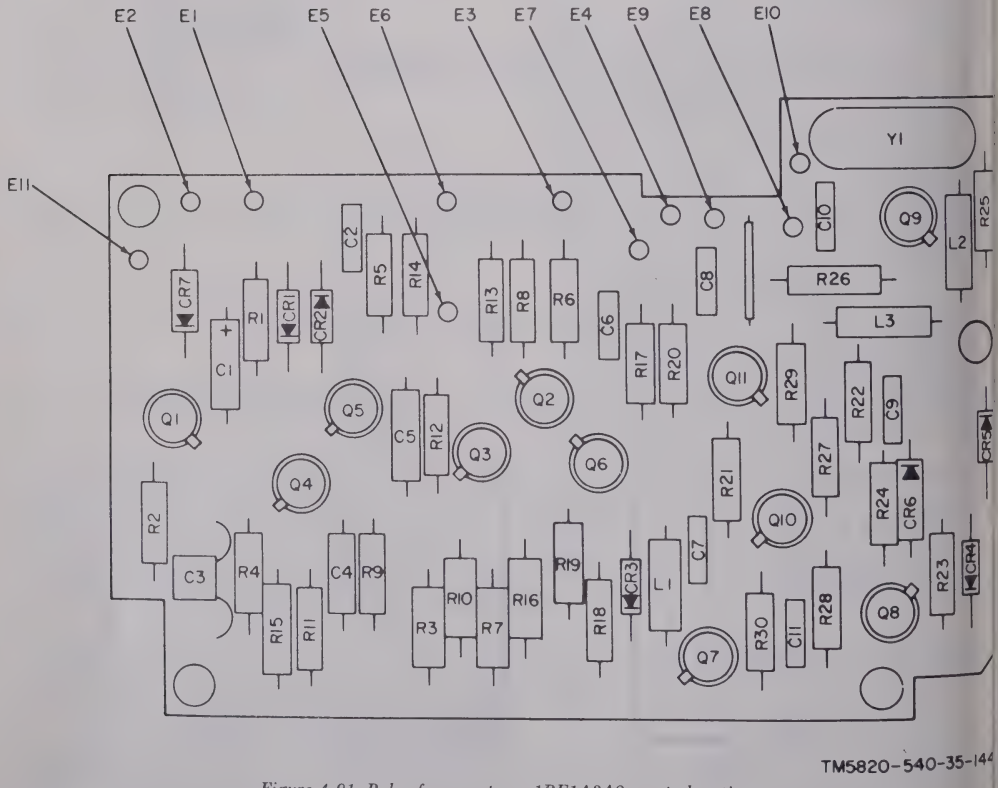


Figure 4-91. Pulse form restorer 1RE1A3A2, parts location.

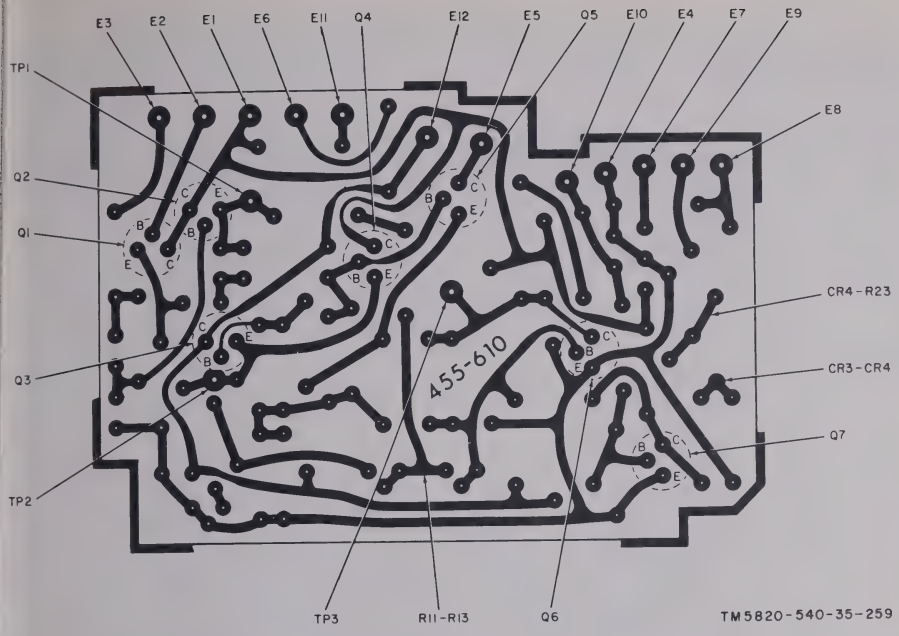


Figure 4-92. Modulation eliminator 1RE1A3A1, printed circuit board.

on 1RE1A3A3 (fig. 4–84C). Adjust R26 t the timing pulses occur 250 nanoseconds the peaks of the pcm signal (fig. 4–85D).

2) *SLICER LEVEL control R13 (1RE1A3–*

ct the test equipment as in (1)(*d*) above djust R13 to minimize the width of the blur e sloping edges of the sawtooth waveform.

3) *PCM CANCEL control R11 and OW E control R24 (1RE1A3A1).*

(*a*) Carry out (*a*) thru (*c*) of the order noise test (*b*(4) above).

(*b*) Adjust R11 PCM CANCEL and R24 OW NOISE control for a minimum indication on the VTVM.

(4) *OW GAIN control R13 (1RE1A3A1).*

(*a*) Carry out (*a*) thru (*d*) of the order wire gain and frequency response test (*b*(5) above).

(*b*) Adjust R13 OW GAIN control R13 for a –10 dbm reading on the VTVM.

e. Typical Waveform Displays. Typical waveform displays are shown in figures 4–198, 4–199, and 4–200. They should be obtained with test facility switch S15 set to PCM & TMG.

f. Transistor in-circuit resistance measurements.

NOTE

All resistances measured with allocated multimeter.

Stage	Transistor		Base (−) to				Base (+) to			
			Emitter (+)		Collector (+)		Emitter (−)		Collector (+)	
	Ref.	Type	Res. (ohms)	Multimeter Range	Res. (ohms)	Multimeter Range	Res. (ohms)	Multimeter Range	Res. (ohms)	Multimeter Range
Electrical synchronizer 1RE1A3A3	Q1	2N706	1,200	x 100	2,800	x 100	825	x 100	700	x 100
	Q2	2N706	3,700	x 100	1,400	x 100	900	x 100	700	x 100
	Q3	2N930	50k	x 10,000	40k	x 10,000	950	x 100	840	x 100
	Q4	2N706	7,000	x 100	4,400	x 100	900	x 100	710	x 100
	Q5	2N706	15k	x 10,000	15k	x 10,000	900	x 100	700	x 100
	Q6	2N706	3,500	x 100	1,400	x 100	900	x 100	670	x 100
	Q7	2N706	7,000	x 10,000	8,000	x 10,000	850	x 100	700	x 100
	Q8	2N706	7,000	x 10,000	8,000	x 10,000	850	x 100	700	x 100
	Q9	2N706	15k	x 10,000	22k	x 10,000	900	x 100	700	x 100
	Q10	2N930	15k	x 10,000	8,000	x 10,000	925	x 100	825	x 100
Pulse Form restorer 1RE1A3A2	Q1	2N2894	1,200	x 100	1,200	x 100	5,000	x 100	5,500	x 100
	Q2	2N706	8,000	x 10,000	7,000	x 10,000	900	x 100	720	x 100
	Q3	2N706	2,700	x 100	2,900	x 100	900	x 100	720	x 100
	Q4	2N706	2,700	x 100	2,800	x 100	900	x 100	700	x 100
	Q5	2N706	8,000	x 10,000	7,000	x 10,000	900	x 100	720	x 100
	Q6	2N706	5,000	x 100	4,000	x 100	900	x 100	800	x 100
	Q7	2N706	13k	x 10,000	13k	x 10,000	950	x 100	760	x 100
	Q8	2N706	34k	x 10,000	30k	x 10,000	900	x 100	730	x 100
	Q9	2N706	700	x 100	4,000	x 100	860	x 100	720	x 100
	Q10	2N706	17k	x 10,000	10k	x 10,000	900	x 100	700	x 100
	Q11	2N706	27k	x 10,000	970	x 100	860	x 100	700	x 100
Modulation eliminator 1RE1A3A1	Q1	2N706	4,000	x 100	900	x 100	900	x 100	650	x 100
	Q2	2N706	4,500	x 100	2,700	x 100	900	x 100	700	x 100
	Q3	2N2894	1,200	x 100	1,200	x 100	17k	x 10,000	10k	x 10,000
	Q4	2N706	18k	x 10,000	9,000	x 10,000	900	x 100	700	x 100
	Q5	2N706	7,900	x 10,000	8,000	x 10,000	900	x 100	700	x 100
	Q6	2N903	8,000	x 10,000	6,900	x 10,000	925	x 100	825	x 100
	Q7	2N706	11k	x 10,000	11k	x 10,000	925	x 100	850	x 100

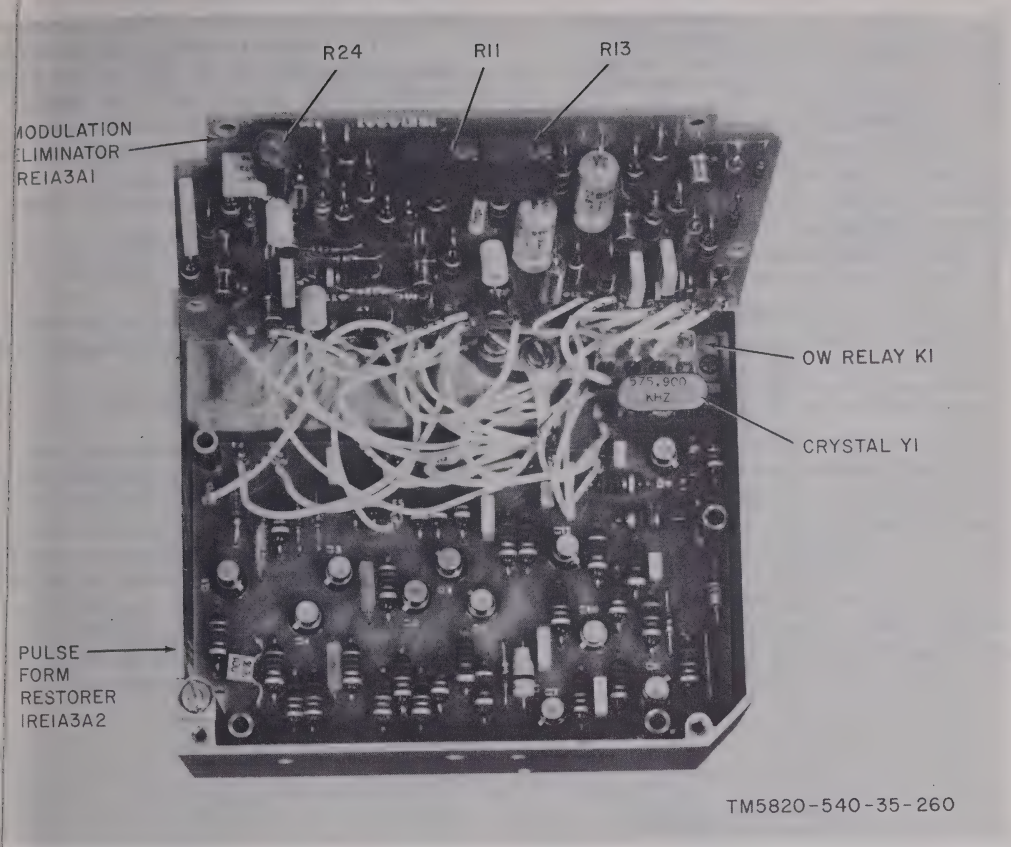


Figure 4-93. Pluse form restorer 1RE1A3 opened showing pulse form restorer 1RE1A3A2.

7. Electrical Frequency Limiter-Discriminator 1RE1A4

. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Receiver MK-2867(V)1/GRM-95(V)	Receiver Test Facility
Accessory Kit, Test Facilities Set TS-1173(V)1/GRM-95(V)	Accessory Kit
Oscilloscope AN/USM-281 complete with vertical and horizontal units	Oscilloscope
Voltmeter, Electronic ME-30A/U	VTVM
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) *Discriminator characteristics check.*

(*a*) Remove the cover on the P1 side of the unit under test and replace it with the T-41542 cover plate (part of the receiver test facility).

(*b*) Connect the test equipment as shown in figure 4-94.

(*c*) Set the test facility switches as follows:

Switch	Position	Normal indication
S1	ON	AC, -12V, +12V, and +26V lamps illuminate. If +12V lamp is not on refer to *c* below.
S5	MODEM -12V	M1 should indicate in the green band.
S5	S9	
S14	30 MHz	

Switch	Position	Normal indication
S9	30 MHz	M1 should indicate in the green band.
S9	50 kHz	M1 should indicate in the green band.
S9	DISCR RESPONSE	

(*d*) The curve from the unit under test displayed on the oscilloscope channel B should be almost identical to the S-shaped curve displayed on channel A. If necessary adjust R1, C2, and C3 to produce a nearly identical curve with a 2v peak-to-peak separation. (fig. 4–95A).

NOTE

DO NOT ADJUST capacitor C1. C2 controls the right side of the trace (high frequency end); C3 controls the left side of the trace (low frequency end); R1 controls the slope of the trace.

(*e*) Set test facility switch S9 to the DISCR DERIVATIVE position.

(*f*) Readjust R1, C2, and C3 to obtain in a trace on channel B that is identical to or flatter than the trace displayed on channel A (fig. 4–95B).

(*g*) Connect the test equipment as shown in figure 4–96A; connect the 2k-ohm terminated cable to the J26 (CHAN A) connector.

(*h*) Set test facility switches S9 to 300 kHz and S14 to 30 MHz. Set the coaxial sw in position 2. Record the VTVM indicatio

(*i*) Transfer the 2k-ohm terminated from J26 (CHAN A) to J33 (CHAN B). VTVM should indicate as in (*h*) above.

(*j*) If necessary, adjust potentiomete on the unit under test to obtain the VTVM indication as in (*h*) above.

(*k*) Set test facility switch S1 to OF

(2) *Frequency response check.*

(*a*) Connect the test equipment as sh in figure 4–96B.

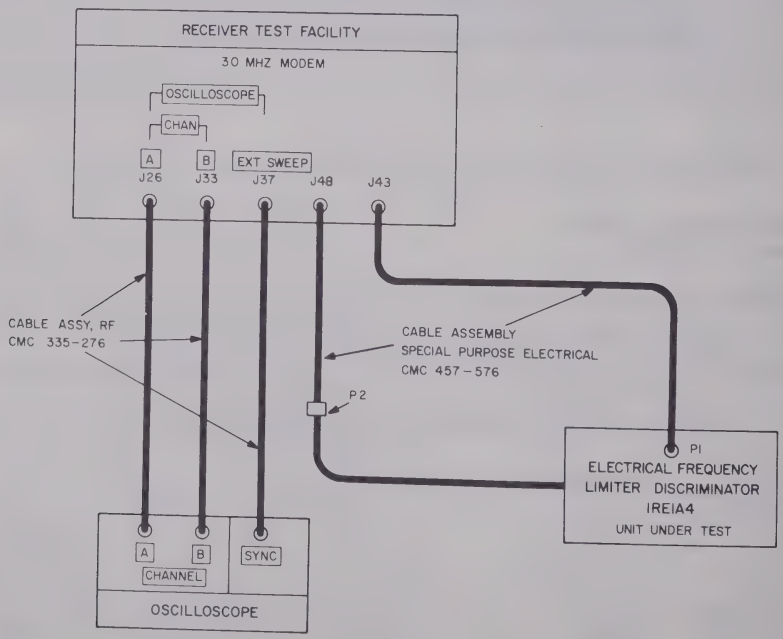
(*b*) Set the output level of the wide r oscillator to minimum and set the variable att ator to zero attenuation.

(*c*) Set test facility switches S9 to video and S1 to ON.

(*d*) Tune the wide range oscillator t kHz. Set the coaxial switch to position 2, con ing modem connector CHAN B to VTVM.

(*e*) Adjust the wide range oscillator put level for a 24-mc indication on the VT

(*f*) Set the coaxial switch to positio connecting the wide range oscillator to VTVM. Adjust the variable attenuators to duce the same VTVM reading as in (*e*) a Note the setting of the attenuators.



TM5820-540-35-221

Figure 4-94. Electrical frequency limiter-discriminator 1RE1A4, modem characteristics check, test set-up.

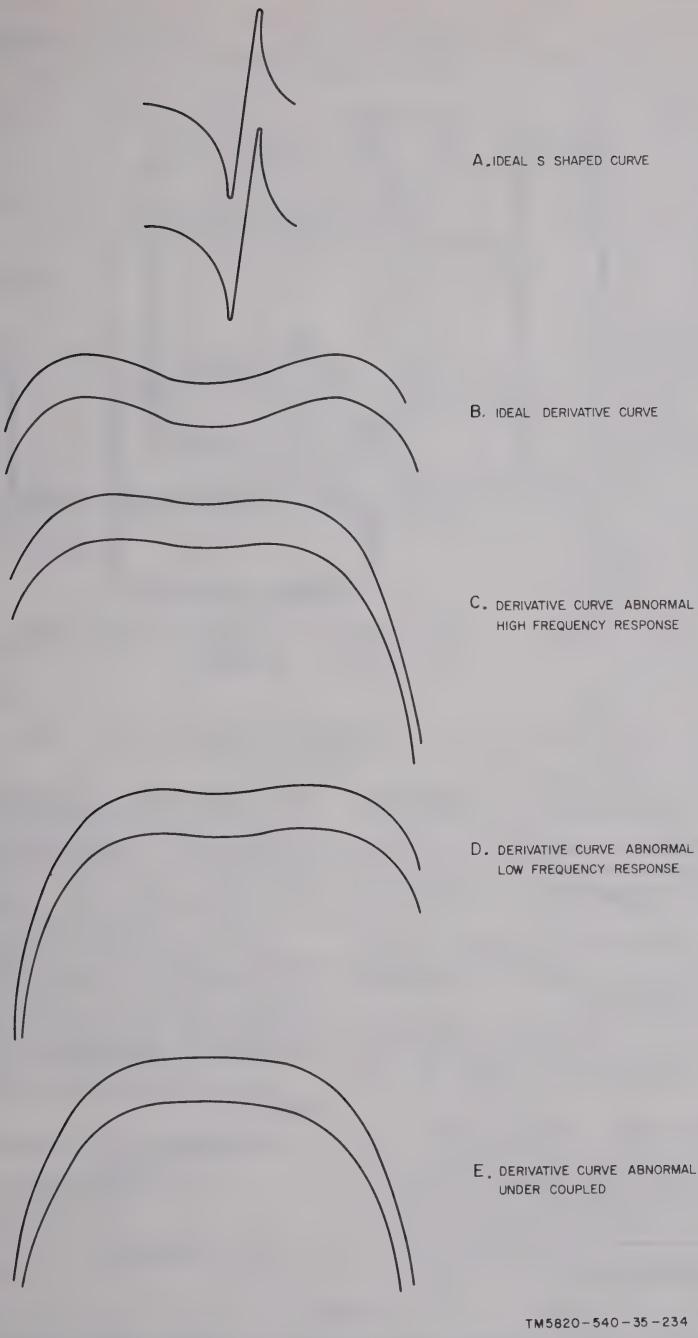


Figure 4-95. Electrical frequency limiter-discriminator 1RE1A4, waveform displays.

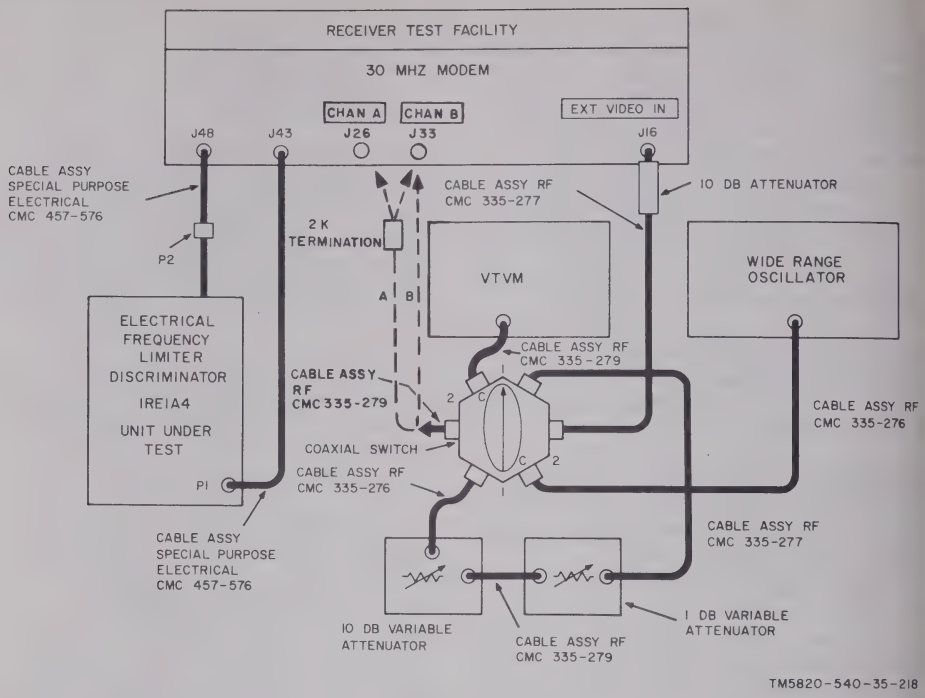


Figure 4-96. Electrical frequency limiter-discriminator 1RE1A4, frequency response, test set-up.

(*g*) Set the coaxial switch to position 2. Tune the wide range oscillator to 125 kHz and adjust the output level as in (*e*) above.

(*h*) Set the coaxial switch to position 1. Adjust the variable attenuators until the VTVM indicates 24 mv.

(*i*) The variable attenuator settings should be between -0.5 db and +1.5 db of the attenuation noted in (*f*) above.

(*j*) Repeat (*g*) and (*h*) above for 960 kHz. The attenuator settings should be between 0 db and -2.0 db of the attenuation noted in (*f*) above.

c. Troubleshooting (fig. 6-23).

(1) *Dc supply check.* If the test facility -12v indicator lamp does not light, disconnect the -12v line to each section of the unit under test in turn, starting with 1RE1A4AR1 (fig. 4-97). test facility -12v indicator lamp will light faulty section is reached. Replace the faulty tion. Check the -12v dc at E5 (1RE1A4A E1 (1RE1A4A4) and E1 (1RE1A4A3).

(2) *Preliminary capacitor set-up.* If C1 or C3 (1RE1A4A5) is replaced while tro shooting, carry out the following preliminary justments on the replacement capacitor b repeating the test procedure in *b* above.

(*a*) Turn C1, C2, or C3 clockwise t stop.

(*b*) Turn C1—5 turns counterclockw

C2—2 turns counterclockw

C3—9 turns counterclockw

(3) *Troubleshooting chart.*

NOTE

The rms voltages in the chart are typical indications measured with the allocated oscilloscope.

Symptom	Probable cause	Checks and corrective measur
No output indication (*b*(1)(*d*) above).	*a.* Defective electrical noise limiter 1RE1A4A3 (fig. 4-97).	*a.* Set test facility switch S9 to 30 MHz. With the oscilloscop check the input signal at E2 (1.125v rms) and output sign

) *Troubleshooting chart* (cont).

Symptom	Probable cause	Checks and corrective measures
		at E5 (1.5v rms) (fig. 4-97). If output signal is abnormal, replace 1RE1AR4A3.
	b. Defective electrical noise limiter 1RE1A4A4.	*b.* Check the output signal at E5 (1.0v rms). If abnormal, replace 1RE1A4A4.
	c. Defective discriminator sub-assembly 1RE1A4A1 or C1 of 1RE1A4A5.	*c.* Check the signal at E3 (approx. 1.25v rms). If indication is abnormal disconnect and check C1 and C4 of 1RE1A4A5. Replace if necessary; if C1 and C4 are abnormal, replace 1RE1A4A1. Check voltage at E6 (1.375v rms) and E7 (2.125v rms). Replace 1RE1A4A5 if indications are abnormal.
	d. Defective video amplifier 1RE1A4AR1.	*d.* Check the signal at E3 (400 mv rms). If indication abnormal, replace 1RE1A4AR1.
half of S-shaped curve sing (*b*(1)(*d*) above).	*a.* Defective 1RE1A4A1—diode CR1 shorting or TP1 open circuit.	*a.* Check resistance of diode CR1 (across E6 and ground) and Continuity of T1 (E5 to ground). If indications are abnormal, replace 1RE1A4A1.
	b. Defective capacitor C3 (1RE1A4A5).	*b.* Check C3 for short circuit; replace if necessary.
half of S-shaped curve sing.	*a.* Defective 1RE1A4A1—diode CR2 shorting or TP1 open circuit.	*a.* Check resistance of CR2 (across E7 and ground) and continuity of T1 (E4 to ground). If indications are abnormal, replace 1RE1A4A1.
	b. Defective capacitor C2 (1RE1A4A5).	*b.* Check C3 for short circuit; replace if necessary.
requency end of DISCR RIVATIVE curve abnormal . 4-95C).	Defect]]e C3 (1RE1A4A5).	Replace C3 and repeat tests.
requency end of DISCR RIVATIVE curve abnormal . 4-95D).	Defective C2 (1RE1A4A5) or C1 (1RE1A4AR1).	Replace C2 and repeat test procedure above. If results unsatisfactory, replace 1RE1A4AR1 and repeat tests.
R DERIVATIVE curve abnormally in center: 30 MHz under-upled (fig. 4-95E).	Defective C1 (1RE1A4A5).	Replace 1RE1A4A5 and repeat test procedure above.
requency response abnormal.	Defective C1 or C2 (1RE1A4A5).	Replace 1RE1A4A5 and repeat test procedures above.

Amplifier-Frequency Multiplier 1RE1A5

Test Equipment and Material Required.

Equipment	Common Name
Facility, eceiver S-2867(V)1/ RM-95(V)	Receiver test facility
essory Kit, est Facilities Set IK-1173(V)1/ RM-95(V)	Accessory kit
erator, Sweep ignal AN/USM-203	Sweep generator
erator, Signal N/USM-44A	Signal generator
tmeter AN/URM-98	Power meter
timeter TS-352B/U	Multimeter
Oscilloscope AN/USM-281	Oscilloscope

b. Test Procedure.

(1) Connect the test equipment as shown in figure 4–98.

(2) Set the test facility switches as follows:

Switch	Switch Position	Normal indication
S1	ON	
S5	S6	
S12	AMPL. FREQ. MULT.	
S6	OSC.	

Switch	Position	Normal indication
S8	47.5 MHz	Power meter should indicate +14 dbm +3 db −0 db. Multimeter connected to test facility connectors J30 and J31 should indicate **300 mv ± 150 mv.**

(3) Turn S8 to all frequencies in turn power meter should indicate +14 dbm +3 −0 db.

(4) If an unstable output is obtained align the module as described in *d* below.

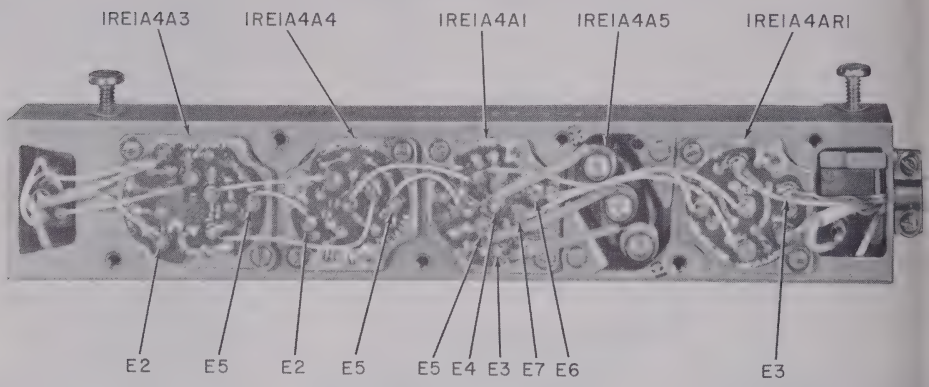


Figure 4-97. Electrical frequency limiter-discriminator 1RE1A4, cover removed.

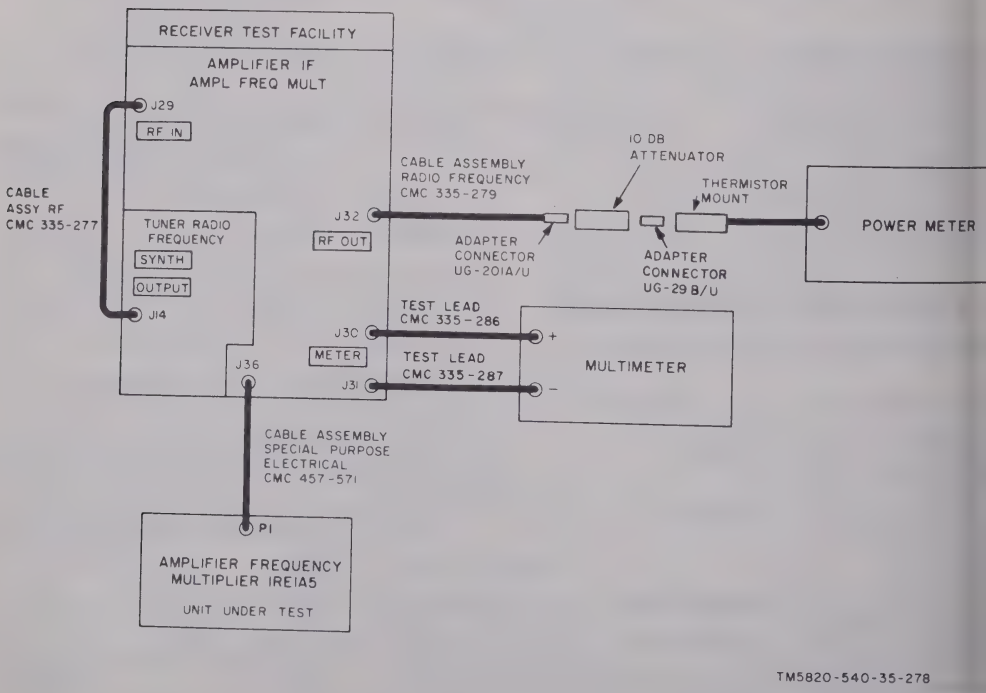


Figure 4-98. Amplifier-frequency multiplier 1RE1A5, test set-up.

Troubleshooting (fig. 627).

Symptom	Checks and corrective measures
tput, no multimeter cation	*a.* Check +12v dc and −12v dc supply circuits to transistor stages. *b.* Using oscilloscope check input signal at (1RE1A5FL1) E1 and E3 as shown in chart below. If signal is not present at E3 check the continuity of L1 through L4 (1RE1A5FL1) (fig. 4-31 and 4-99). Check connector and cable A1 to E1 (1RE1A5FL1). *c.* Check signal through transistor stages (chart below) and observe doubler action. If signal at Q1 is abnormal, check continuity of transformer T1 windings and forward and reverse resistances of diode CR1. *d.* Check continuity of components from Q3 to E4 and cable from E4 to connector A2 and P1. Repair or replace components as required.
t normal, no multim- reading.	Check components in meter circuit: L13, CR2, C1, and C27; (fig. 4-100) replace as required.
utput.	*a.* Use the oscilloscope to check gain of transistor stages as shown in chart below. *b.* Check and replace R9 (1RE1A5A1) if necessary. Check the alignment and frequency response as described in *d* below.
ive output	Check R1 and R2 for open circuit; resolder connections if loose.

Test points	Typical indications
	3.0 mv pp
	3.0 mv pp
-Base	50 mv pp
-Collector	200 mv pp
2-Base	200 mv pp
2-Collector	425 mv pp
3-Base	425 mv pp
3-Collector	425 mv pp

d. Alignment Procedures.

(1) *Frequency response adjustments.*

(*a*) Calibrate the sweep generator output level to 9 dbm through the frequency range of 47 to 73 MHz, with the function switch set to SWEEP.

(*b*) Remove the protective screwed caps from the six tuning capacitors on the unit under test.

(*c*) Connect the test equipment as shown in figure 4–101A.

(*d*) Set test facility switches S1 to ON and S12 to AMPL FREQ MULT.

(*e*) Set the controls on the unit under test as follows:

Control	Position
C11	Mid-range
C23	Mid-range
C24	Mid-range
R9	Mid-range
L8	Slug flush with top of coil.
C5	3 turns cw from max ccw position.
C17	Fully ccw (min capacitance).
C14	Fully cw, (max capacitance).
R1 and R2	Fully ccw (min resistance).

(*f*) Adjust C5 clockwise until the vertical amplitude of the frequency response display stops increasing.

(*g*) Adjust C23 for maximum amplitude response at 75 MHz.

(*h*) Adjust C24 for maximum amplitude response at 47.5 MHz.

(*i*) Adjust C17 to increase or decrease the amplitude response of the upper half of the band, (60 to 70 MHz).

(*j*) C11 and C14 affect the overall flatness of the response. C14 will normally be at maximum capacitance and C11 about three-quarters maximum.

(*k*) Vary L8 in conjunction with C17 to adjust the response tilt. Increasing C17 capacitance slightly (cw) will increase the amplitude of the upper half of the band, while adjusting L8 will increase the amplitude of the lower half of the band. Alternate between C17 and L8 for maximum amplitude and least passband ripple.

(*l*) Repeat (*f*) through (*k*) above for maximum amplitude response and minimum pass-

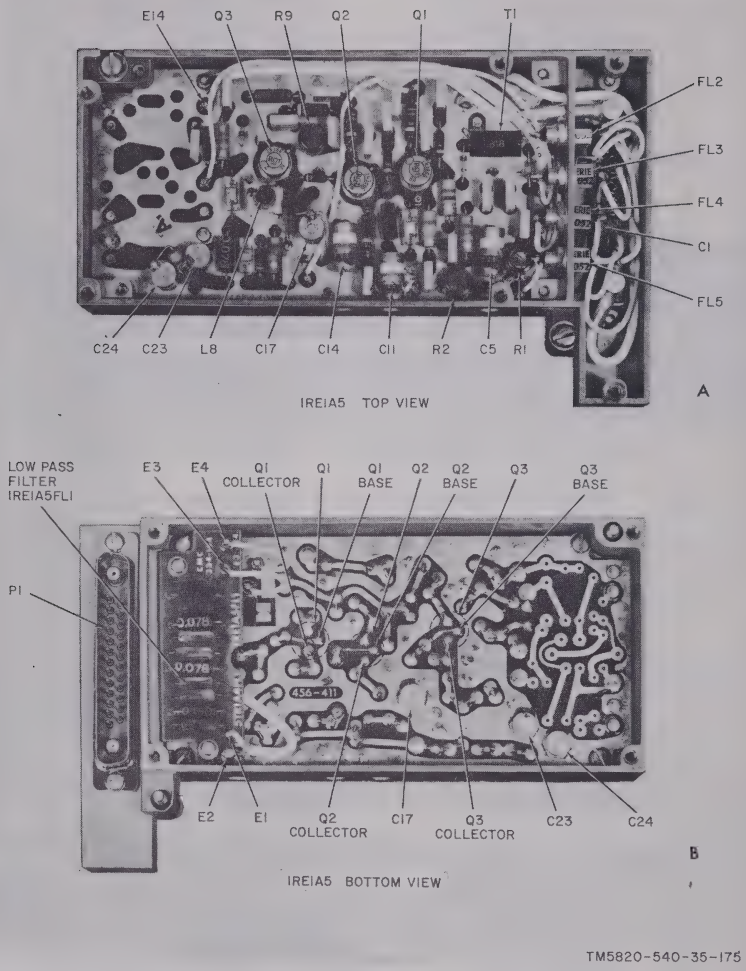


Figure 4-99. Amplifier frequency multiplier 1RE1A5, top and bottom views (covers removed).

band ripple between 47.5 and 72.5 MHz as shown in figure 4–102.

(*m*) Adjust R9 for an output level of +14 dbm +3 db –0 db as measured on the power meter connected to test facility connector J32 (RF OUT).

(2) *Harmonic rejection tests.*

(*a*) Disconnect the rf detector from the test set-up and connect a 3 db attenuator followed by the 100–190 MHz tunable filter, between test facility connector J32 (RF OUT) and the detector as shown in figure 4–101B.

(*b*) Set the sweep generator SWEEP to 48.3 MHz and the tunable filter to MHz.

(*c*) Adjust R1 and R2 on the unit t test for minimum amplitude of the third monic as displayed on the oscilloscope. Note amplitude.

NOTE

Increase the vertical sensitivity of oscilloscop to 2 mv/cm to see minimum point of balanc On the unit under test keep R1 and R2 as clos to minimum resistance as possible.

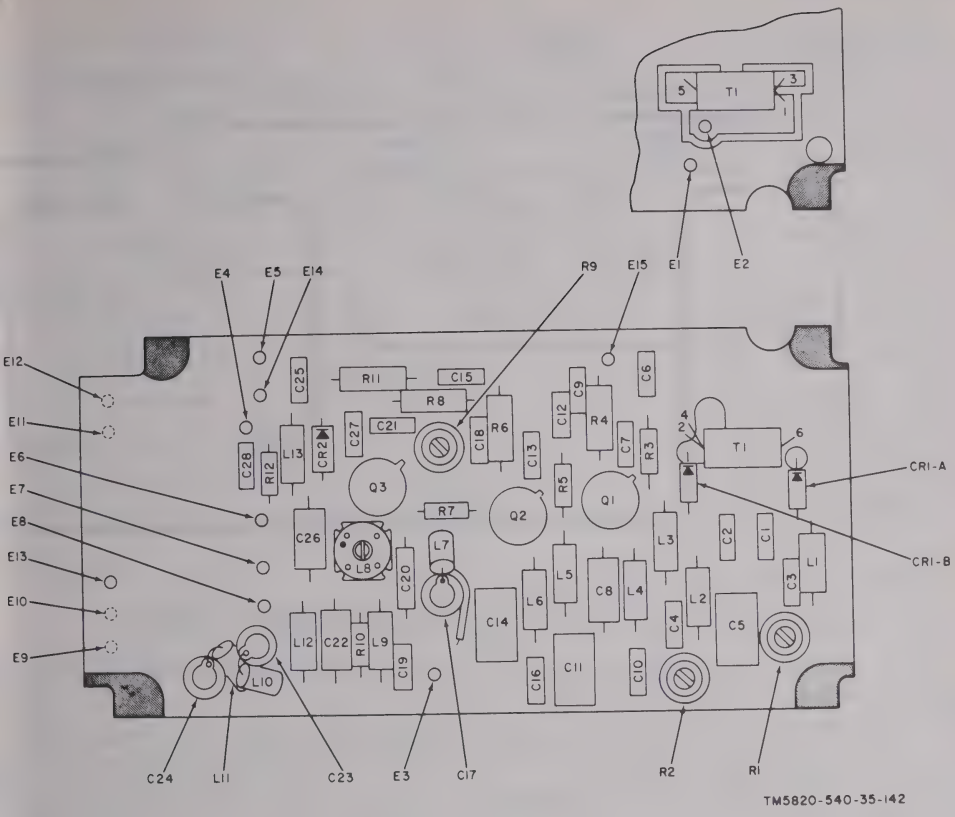


Figure 4-100. Amplifier frequency multiplier 1RE1A5A1, parts location.

(*d*) Rotate the sweep generator SWEEP rom 48.3 to 65 MHz. At the same time tune nable filter from 144.9 to 195 MHz. Check that the third harmonic amplitude stays be- ne level noted in (*c*) above. Note the fre- y at which the third harmonic is at its high- vel. R1 and R2 may need to be readjusted e lowest possible third harmonic over this

(*e*) Set the sweep generator SWEEP dial 3 MHz and the tunable filter to 193.2 MHz.

(*f*) Adjust C23 slightly on the unit under o minimize the fourth harmonic (193.2 .

(*g*) Replace the 100–190 MHz tunable with the 50–90 MHz tunable filter.

(*h*) Rotate the sweep generator SWEEP rom 48.3 to 72.5 MHz. At the same time the tunable filter from 48.3 to 72.5 MHz. to see that the fundamental response is at as low as the third harmonic noted in (*d*) above. Note the frequency at which the fundamental frequency is at its highest level. If necessary, repeat (*d*) through (*h*) above until a comparable minimum is reached.

(*i*) Connect the test equipment as shown in figure 4–103A.

(*j*) Set the signal generator output to +12 dbm.

(*k*) With the 100–190 MHz tunable filter connected in the circuit, measure the third harmonic level at the frequency noted in (*d*) above. It should not be greater than –10 dbm.

(*l*) Set the signal generator frequency to 48.5 MHz and the tunable filter to 194 MHz.

(*m*) Measure the fourth harmonic level. It should not be greater than –10 dbm.

(*n*) Connect the 50–95 MHz filter in place of the 100–190 MHz filter.

(*o*) Set the signal generator to the frequency noted in (*h*) above. Measure the level

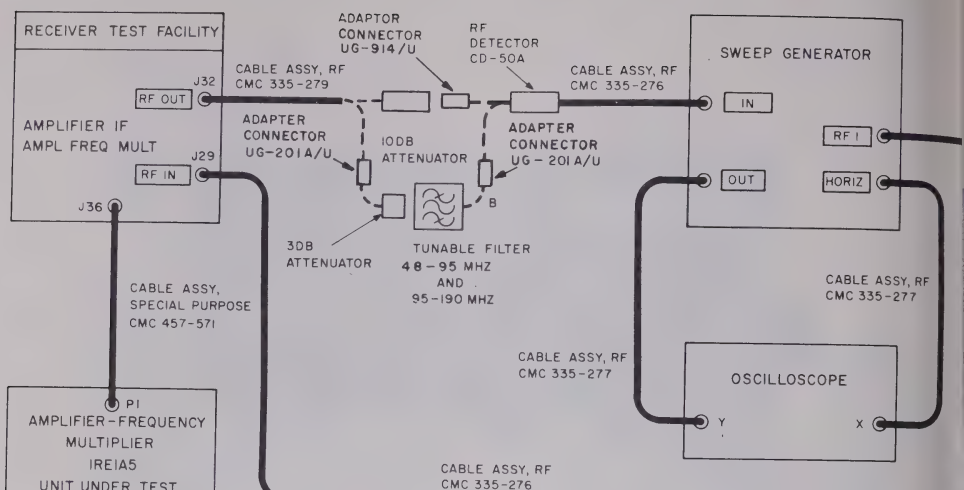


Figure 4-101. Amplifier-frequency multiplier 1RE1A5 alignment, test set-up.

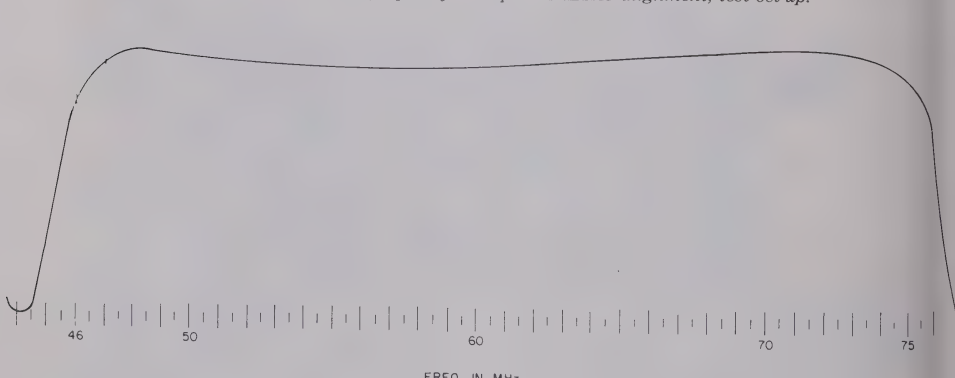


Figure 4-102. Amplifier-frequency multiplier 1RE1A5, frequency response.

of the fundamental frequency. It should not be greater than –10 dbm.

(*p*) Set the signal generator and tunable filter to 60 MHz. Measure the level of the 60 MHz signal. It should not be greater than –26 dbm. If necessary, adjust either R1 or R2 slightly to bring this measurement within the required value. If R1 or R2 is readjusted, repeat (*d*) above and repeat (*d*) and (*q*) alternately until both test conditions are met.

(*q*) Remove the filter and the 3–db attenuator and connect the power meter through a 10-db attenuator to test facility connector J32 OUT) as shown in figure 4–103B.

(*r*) Vary the signal generator in 2- steps from 47.5 to 72.5 MHz. Note the p meter indication. It should be +14 dbm, +8 –0 db.

(3) *Input vswr check.*

(*a*) Connect the test equipment as sh in figure 4–104A with the power meter conne to vswr detector port Z2.

(*b*) Adjust the output level of the sw generator to +9 dbm over the frequency rang

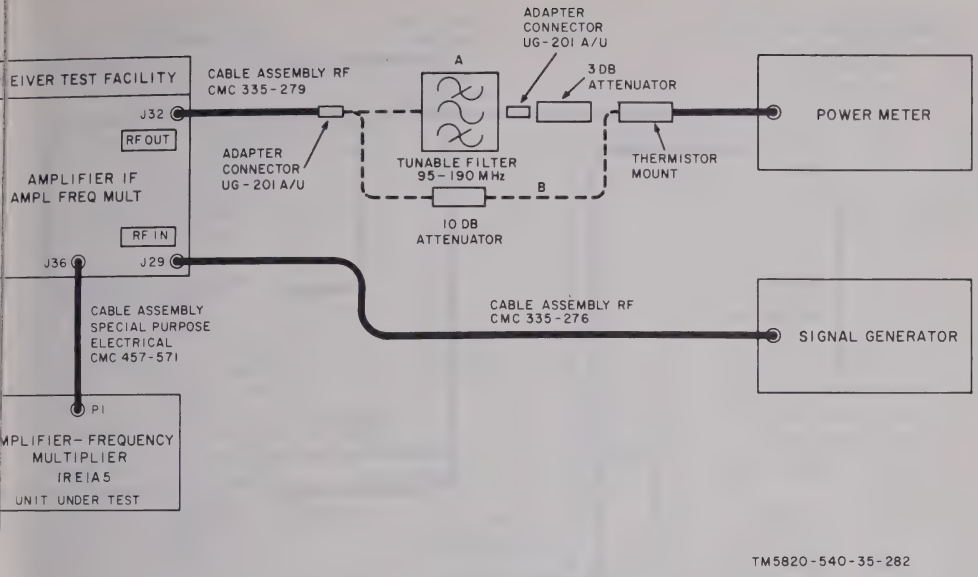


Figure 4-103. Amplifier-frequency multiplier 1RE1A5, output power test set-up.

to 72.5 MHz with function switch set to EP.

(*c*) Disconnect the power meter and connect the 2:1 calibrated mismatch to port Z2 (fig. 4B). Calibrate the oscilloscope.

(*d*) Disconnect the calibrated mismatch connect a cable between test facility connector J29 and vswr detector port Z2 (fig. 4–104C). vswr should be less than 2.0 over the frequency range of 47.5 to 72.5 MHz.

(*e*) Seal all adjusted controls as described aragraph 4–12, and replace the protective ved caps removed in *d* (1)(*b*) above.

9. Video Amplifier 1RE1AR1

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Receiver TS2867(V)1/ GRM-95(V)	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit
Voltmeter, Electronic ME-30A/U	VTVM
Generator, Signal AN/USM-205	Wide range oscillator
Oscilloscope AN/USM-281	Oscilloscope
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) *Amplifier gain and metering checks.*

(*a*) Connect the test equipment as shown in figure 4–105A.

(*b*) Set the test facility switches as follows:

Switch	Position	Normal indication
S1	ON	
S5	S20	
S20	RCVR SIG	
S21	OUT	PCM OUT lamp illuminates.

(*c*) Tune the wide range oscillator to 10 kHz and adjust the amplitude control to obtain a 0.106v rms indication on the VTVM.

(*d*) Remove the VTVM cable from the wide range oscillator and connect it to test facility VIDEO OUT connector J53. The VTVM should indicate 1.98v. If necessary, adjust GAIN control R1 (fig. 4–106) on the unit under test, to correct the indication. The oscilloscope display should be an undistorted sinewave.

(*e*) Connect the test equipment as shown in figure 4–105B.

(*f*) Set test facility switch S20 to the 24 CHAN position. Meter M1 should indicate 50 percent of full scale. Adjust 24 CH METER control R9 on the unit under test for a correct indication.

(*g*) Reduce the wide range oscillator output level until the VTVM indicates 0.5v.

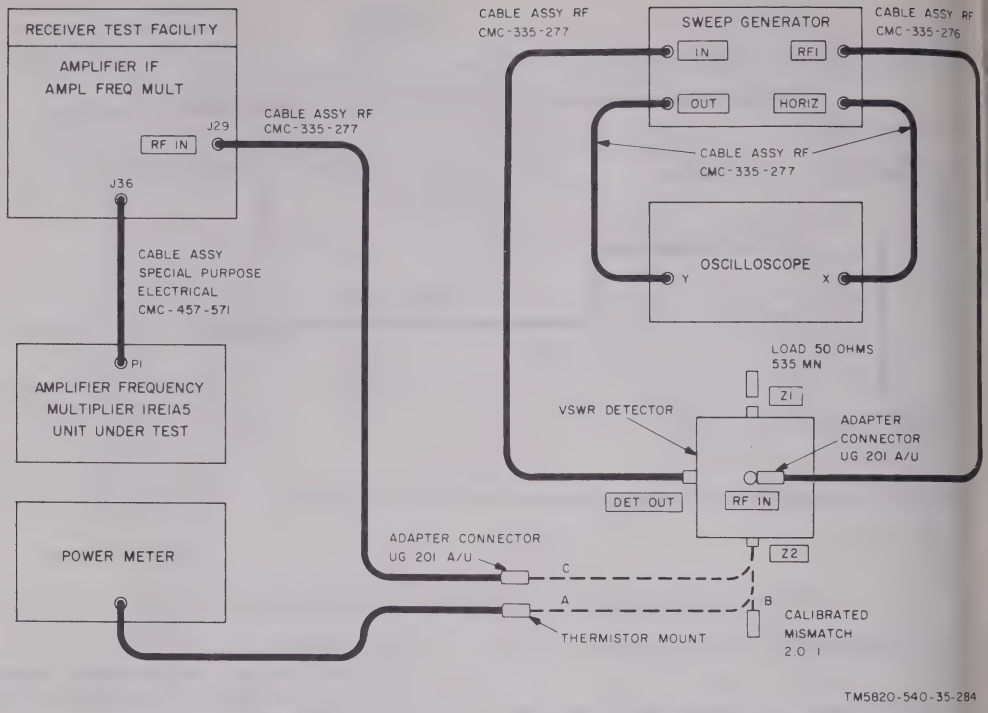


Figure 4-104. Amplifier-frequency multiplier 1RE1A5, input vswr check, test set-up.

(*h*) Set test facility switch S20 to the FDM position. Meter M1 should indicate 50 of percent full scale. Adjust FDM METER control R8 for a correct indication.

(2) *Distortion check.*

(*a*) Terminate the VTVM with a 50-ohm termination as shown in figure 4–105C.

(*b*) Tune the wide range oscillator to 100 kHz.

(*c*) Operate the wide range oscillator amplitude control slowly to increase the signal level until the VTVM indicates 1.0v rms. The sine wave displayed on the oscilloscope should have no visible distortion for signal levels less than 1.0v rms.

(3) *RCVR SIG meter and LOW SIGNAL alarm adjustment.*

(*a*) Remove the cable from test facility VIDEO OUT connector J53 and terminate with a 50-ohm termination.

(*b*) Connect the VTVM and the wide range oscillator to the unit under test as shown in figure 4–107A.

(*c*) Set test facility switch S20 to RCVR SIG and switch S21 to OUT. Meter M1 should indicate 50 percent of full scale. Adjust RCV SIG control R16 for the correct indication.

(*d*) Tune the wide range oscillator 600 kHz and adjust the amplitude control ur the VTVM indicates 27 mv. The PCM OU lamp should go out and the LOW SIGNA alarm lamp should light.

(*e*) Reduce the wide range oscillator o put level to obtain a 25-mv indication on t VTVM. Watch the LOW SIGNAL alarm lan

1. If the LOW SIGNAL alarm lamp out, adjust the LOW SIG ALARM control clockwise until the lamp lights.

2. If the LOW SIGNAL alarm la remains lit, adjust LOW SIG ALARM cont R1 counterclockwise until the lamp goes out. A just R1 slowly clockwise until the lamp ligh again.

(4) *Frequency response check.*

(*a*) Connect the VTVM to test facil connector J53 (fig. 4–107B).

(*b*) Tune the wide range oscillator to kHz.

(*c*) Set test facility switch S20 to RCV SIG and switch S21 to IN.

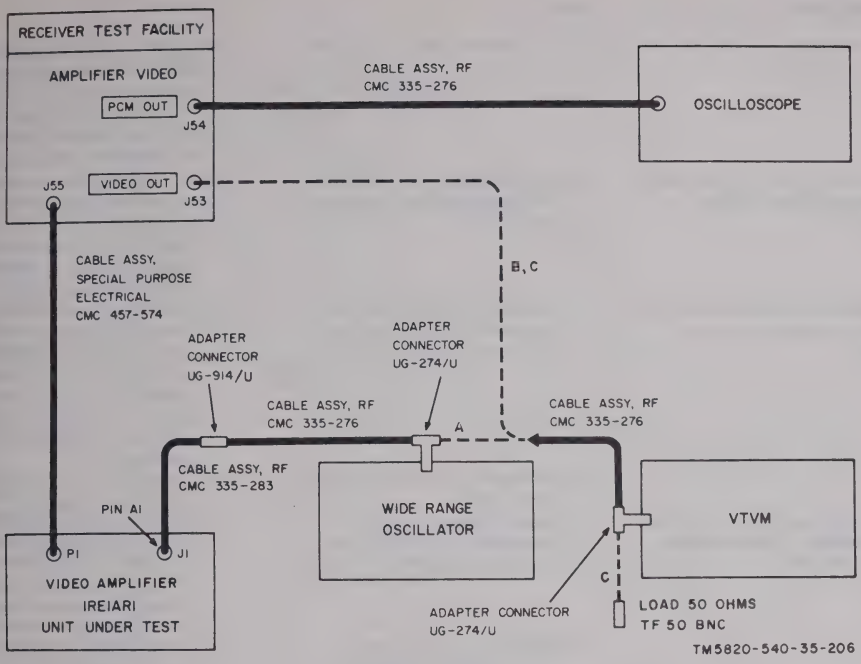


Figure 4-105. Video amplifier 1RE1AR1, amplifier gain, test set-up.

(*d*) Adjust the amplitude control of the range oscillator so that the VTVM indicates db (on the 0.1-volt scale). Note the indica- on the wide range oscillator; this is the rence input level used for the subsequent uency settings.

(*e*) Vary the wide range oscillator frequency up to 960 kHz. Keep the same reference input level ((*d*) above). The indication on the VTVM should stay between **-20 and -23 db.**

(*f*) Set switches S20 and S1 to their OFF positions.

Troubleshooting (fig. 6-24).

Symptom	Probable cause	Checks and corrective measures
OUT indicator lamp does ot light (*b*(1) above).	Defective relay K1 (fig. 4-106).	Check the continuity of relay contacts B2 to B3. Replace relay if necessary.
or no output at VIDEO OUT Test facility connector J53). ll meter indications abnormal.	*a.* +12v dc or -12v dc shorting to ground.	*a.* Set test facility switch S5 to positions -12V and +12V. M1 should indicate in the green band. If -12V or +12V reading is abnormal, disconnect the voltage line at the printed circuit boards in turn to isolate problem. Check for short circuiting component.
	b. Defective video amplifier 1RE1AR1AR1 (fig. 4-108 and 4-109).	*b.* Check the signal through amplifier to isolate the defective stage. Check resistance of components in isolated stage. Refer to *d* below for typical readings.
orted sinewave at VIDEO UT connector.	Defective transistor stage in video amplifier 1RE1AR1AR1 (fig. 4-108 and 4-109).	Use the oscilloscope to check the signal at the collectors of transistors Q1 through Q3, Q5

c. Troubleshooting (fig. 6-24) (cont).

Symptom	Probable cause	Checks and corrective measures
		and Q6, and at the emitter of Q4 and E3. Check resistance of components in isolated stage (*d* below). Replace the defective component.
Abnormal 24 CHAN or FDM meter indications, VIDEO OUT normal.	Defective stage in video monitor 1RE1AR1A2 (fig. 4-110 and 4-111).	Check the signal at points suggested in *d* below to isolate the defective stage (fig. 4-112). Check resistance of components in isolated stage. Replace the defective component.
Abnormal RCVR SIG metering indication, all other indications normal.	*a.* Defective component in alarm control 1RE1AR1A3 (fig. 4-106 and 4-113).	*a.* Check the voltage at E7; it should read approximately 9.5v dc. If abnormal reading is obtained, check diode CR6, resistors R14, R15, and R16 (fig. 4-114). Replace the defective component as required.
	b. Defective L2 (1RE1AR1AR1) (fig. 4-115).	*b.* Check L2 for open circuit; replace if necessary.
LOW SIGNAL lamp does not illuminate, PCM OUT light remains on (*b*(3) above).	*a.* Defective stage in alarm control 1RE1AR1A3 (fig. 4-110 and 4-116).	*a.* Check the signal through FL1 at test points suggested in *d* below to isolate the defective stage (fig. 4-117). Check resistance of components; replace as required.
	b. Defective stage in alarm control 1RE1AR1A3 (fig. 4-106 and 4-113).	*b.* Check the signal at test points suggested in *d* below to isolate the defective stage (fig. 4-114). Check resistance of *components in faulty stage; replace* components as required.
	c. Defective relay K1.	*c.* Check operation of relay K1; replace if necessary.
24 CHAN meter indication and VIDEO OUT level excessively high.	Video amplifier 1RE1AR1AR1 transistor stage Q2 oscillating due to: 1. Defective capacitor C8.	Disconnect the input signal to unit. If meter M1 does not indicate zero: 1. Check and replace capacitor C8.
	2. Open ground wire to 1RE1AR1AR1.	2. Check continuity of ground circuit.
Poor frequency response.	*a.* Defective capacitors C6, C7, and C13.	*a.* Check capacitors by bridging component with equivalent or by substitution. Replace component when output improves.
	b. Defective transistor Q2 (high or low frequency characteristics changed).	*b.* Replace Q2.

d. Voltage and Resistance Measurements.

NOTE

All ac measurements are taken with reference to chassis ground using a VTVM. Dc and resistance are measured w the allocated multimeter.

(1) *Voltage measurements.*

Test points	Typical indications (v rms unless otherwise indicated)	Remarks
		Video amplifier 1RE1AR1AR1 (fig. 4-109)
E1	0.106	Terminate VIDEO OUT with 50

Test points	Typical indications (v rms unless otherwise indicated)	Remarks
		ohm load, except where indicated.
1-Base	0.022	
1-Collector	0.020	
2-Base	0.020	
2-Collector	0.75	
3-Base	0.019	
3-Collector	1.94	
4-Emitter	2.15	
5-Collector	0.032	
5-Emitter	2.00	
6-Base	0.032	
6-Collector	2.00	
3	2.00	VIDEO OUT not terminated.
7	2.00	
		Video monitor 1RE1AR1A2 (fig. 4-111)
1	2.00	
Q1-Base	1.98	
Q1-Collector	3.70	
Q2-Emitter	3.70	
C4 and R10-+5(-)9.5v dc		
R11 and R6-E5(-)9.2v dc		
		High pass filter 1RE1AR1FL1 (fig. 4-116)
E1	0.217	
Q1-Base	0.023	
Q1-Collector	0.032	
E3	0.0185	
		Alarm control 1RE1AR1A3 (fig. 4-113)
E9	0.0185	
Q1-Collector	0.021	
Q1-Emitter	0.0185	
Q2-Base	0.020	
Q2-Collector	1.75	
Q3-Collector	3.62	For "alarm off" condition below, remove the wide range oscillator from J1 of 1RE1AR1 (fig. 4-107).
Q3-Emitter	2.14	
T1 pin 1 to pin 2	1.35	
Q5-Base	-0.6v dc	Alarm off
	+0.7v dc	Alarm on
Q5-Collector	+11.7v dc	Alarm off
	+0.55v dc	Alarm on
Q4-Base	+11.7v dc	Alarm off
	+11.2v dc	Alarm on
Q4-Collector	0v	Alarm off
	+12v dc	Alarm on

(2) *Transistor in-circuit resistance measurements.*

Stage	Transistor Ref.	Transistor Type	Base (−) Emitter (+) Res. (ohms)	Base (−) Emitter (+) Multimeter range	Base (−) Collector (+) Res. (ohms)	Base (−) Collector (+) Multimeter range	Base (+) Emitter (−) Res. (ohms)	Base (+) Emitter (−) Multimeter range	Base (+) Collector (−) Res. (ohms)	Base (+) Collector (−) Multimeter range
Video amplifier 1RE1AR1AR1	Q1	2N706	4,900	x 100	4,900	x 100	890	x 100	700	x 100
	Q2	2N706	3,100	x 100	690	x 100	850	x 100	690	x 100
	Q3	2N706	23k	x 10,000	20k	x 10,000	860	x 100	730	x 100
	Q4	2N706	2,200	x 100	970	x 100	890	x 100	600	x 100
	Q5	2N697	950	x 100	60k	x 10,000	790	x 100	720	x 100
	Q6	2N697	7,000	x 100		x 10,000	780	x 100	710	x 100
Video monitor 1RE1AR1A2	Q1	2N697	10k	x 10,000	16k	x 10,000	790	x 100	720	x 100
	Q2	2N930	16k	x 10,000	3,750	x 100	900	x 100	800	x 100
High pass filter 1RE1AR1FL1	Q1	2N706	7,000	x 100	2,200	x 100	860	x 100	700	x 100
Alarm control 1RE1AR1A3	Q1	2N706	7,000	x 100	3,500	x 100	900	x 100	700	x 100
	Q2	2N706	28k	x 10,000	25k	x 10,000	870	x 100	720	x 100
	Q3	2N706	2,700	x 100	970	x 100	870	x 100	650	x 100
	Q4	2N1132	910	x 100	900	x 100	10k	x 10,000	20k	x 10,000
	Q5	2N930	700	x 100	24k	x 10,000	900	x 100	820	x 100

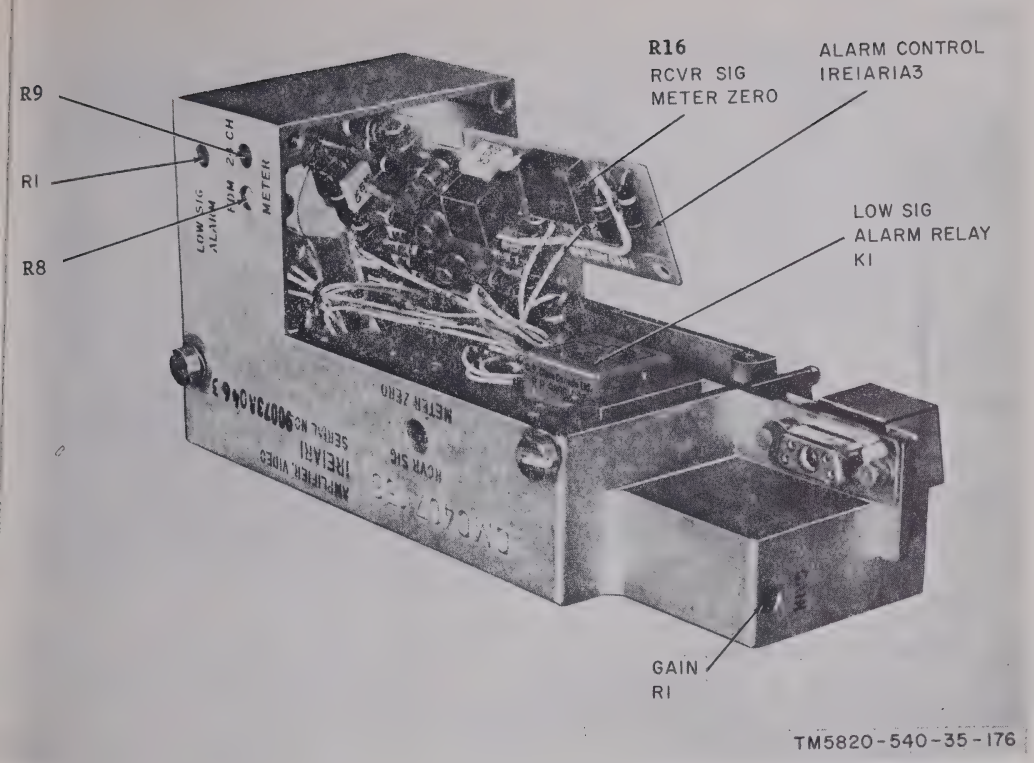


Figure 4-106. Video amplifier 1RE1AR1, top covers removed.

4-50. Intermediate Frequency Amplifier 1RE1AR2

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility Receiver TS2867(V)1/ GRM-95(V)	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit
Wattmeter AN/URM-98	Power meter
Oscilloscope AN/USM-281	Oscilloscope
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) Connect the test equipment as shown in Figure 4-118.

(2) Set the test facility switches as follows:

Switch	Position
S14	30 MHz
S9	30 MHz
S12	AMP IF
Attenuator AT1	40 DB
S13	MAN
S1	ON

(3) Set the variable attenuators to mid range and adjust the GAIN control (above switch S13) for a 0-db indication on the power meter.

(4) Set test facility switch S13 to AGC. The power meter should indicate –3 db ± 1.5 db.

(5) Set test facility attenuator AT1 to 50 db and the GAIN control to maximum (fully clockwise).

(6) Set test facility switch S13 to MAN position and adjust the variable attenuators for a –10 dbm indication on the power meter. Note the setting of the attenuators and use as reference.

(7) Set the test facility switch S14 to 29 MHz. Readjust the variable attenuators for a –10 dbm indication on the power meter. Note the setting of the attenuators.

(8) Set test facility switch S14 to 31 MHz. Readjust the variable attenuators for a –10-dbm indication on the power meter. Note the setting

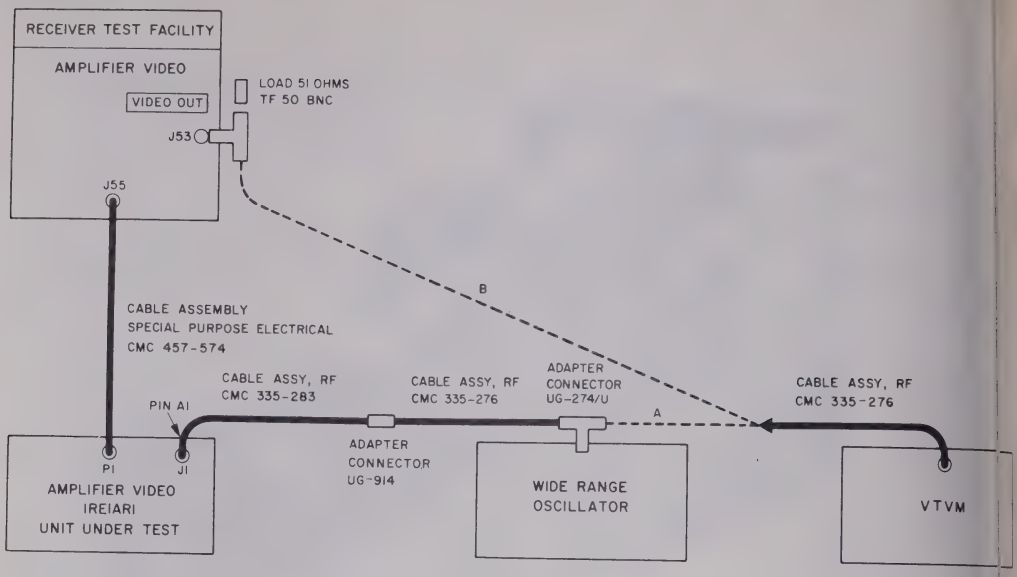


Figure 4-107. Video amplifier 1RE1AR1, RCVR SIG metering and LOW SIGNAL alarm check, test set-up.

of the attenuators. The difference between the attenuator settings at 29 MHz and 31 MHz should not exceed 3 db and must be within ± 1.5 db of the reference setting noted in (6)above.

(9) Set test facility switches S12 and S to their OFF positions.

c. Troubleshooting. (fig. 6–22).

Symptom	Probable cause	Checks and corrective measures
1. Steps *b*(3) and (4) above: Low or no output.	*a.* Loss of agc voltage.	*a.* Set the test facility switch S13 to MAN and the AGC GAIN control to minimum (fully cCW). Check for −11v dc at the following points: E6 and E3 (1RE1AR2AR5) (fig. 4-119) E3 (1RE1AR2AR2) and E (1RE1AR2AR1). Replace the cordwood module through which agc is not being passed.
	b. One or more defective amplifier cordwood modules.	*b.* Set test facility attenuator AT1 to 30 DB and the AGC GAIN control to maximum (fully cW). Check in turn the output of each cordwood module at the points indicated below with attenuator AT1 set as follows:

Test points	AT1 setting (db)	Normal indicatio (mv rms
E4(1RE1AR2AR1)	30	75
E5(1RE1AR2AR2)	30	225
E4(1RE1AR2AR3)	40	350
E5(1RE1AR2AR5)	40	950

Replace the cordwood module with abnormal output indication.

2. Step *b*(4) above: No agc action.	Defective cordwood module 1RE1AR2A1.	Replace 1RE1AR2A1 and repeat test procedure *b*.

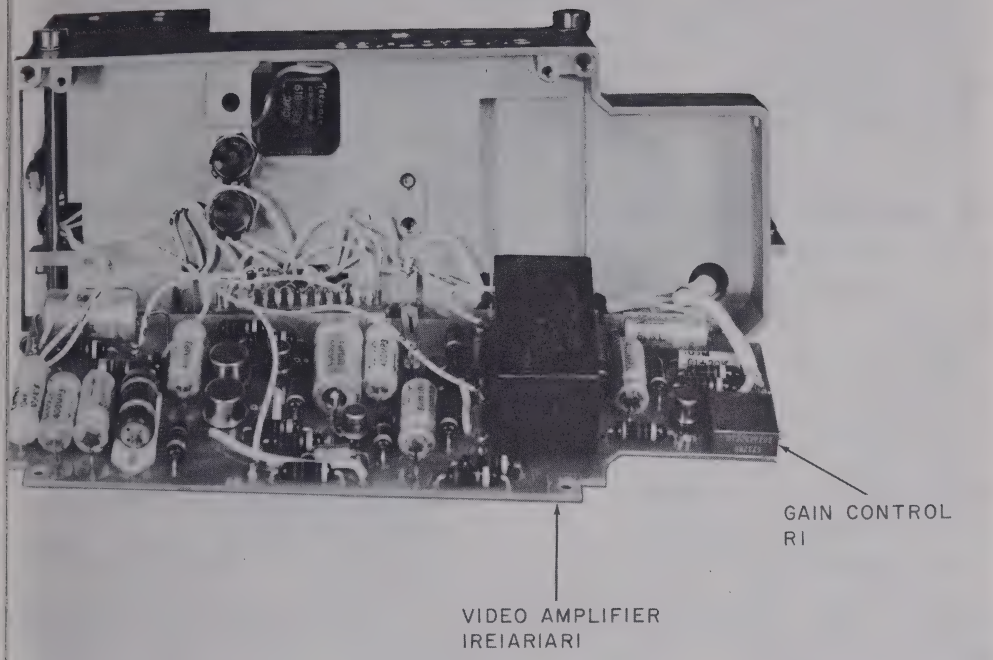


Figure 4-108. Video amplifier 1RE1AR1, bottom cover removed.

-5. Power Supply 1RE1PS1 (Overall)

NOTE

efore checking the complete power supply, check
he heat sink components and voltage regulator
mplifier 1RE1PS1AR1 as described in para-
raph 4-52.

a *Test Equipment and Material Required.*

Equipment	Common Name
st Facility, Receiver TS-2867(V)1/ GRM-95(V)	Receiver test facility
cessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit
scilloscope AN/USM-281.	Oscilloscope

b *Test Procedure.*

(1) Connect the test equipment as shown in
re 4-120.

(2) Set test facility switch S2 to the 24V
ion and press switch S3. Meter M1 should
ate in the green band.

(3) Set switch S2 to the +12V position and press switch S3. Meter M1 should indicate in the green band.

(4) Set the voltage control on the power supply (part of the accessory kit) to 105v ac and 125v ac in turn. Repeat (2) and (3) above for each of the input voltage settings. Meter M1 indication should remain within the green band.

(5) Reset the power supply to 115v ac.

(6) Set switch S2 to the METER +12V position and press switch S3. Meter M1 should indicate in the green band. Observe the ripple voltage on the oscilloscope; the peak-to-peak voltage of 120 Hz ripple should not exceed 2 mv.

(7) Repeat (6) above with switch S2 in the METER –12V position.

(8) Set switch S2 to the 26V UNREG position. Meter M1 should indicate in the green band. Observe the ripple voltage on the oscilloscope; the peak-to-peak voltage of 120 Hz ripple should not exceed 600 mv.

c. Troubleshooting (fig. 6-28).

Symptom	Probable cause	Checks and corrective measures
No meter indication with switch S2 in position +12V.	Defective transistor Q3.	Check resistances of Q3 (para 4-51). Replace if necessary.
No meter indication with switch S2 in position METER -12V.	Defective transistor Q4.	Check resistances of Q4 (para 4-51). Replace if necessary.
High ripple voltage observed with switch S2 in position METER +12V and METER -12V.	No pre-regulation supply or R5 requires adjustment.	Check for 30v dc between TP1 (+) to TP4 (-). If voltage is not present, check and replace CR1 and CR2 (fig. 4-121) if necessary. Readjust R5.

4-52. Power Supply 1RE1PS1 (Chassis)

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Receiver TS-2867(V)1/GRM-95(V)	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V)	Accessory kit
Oscilloscope AN/USM-281	Oscilloscope
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) Remove voltage regulator amplifier 1RE1PS1AR1 (fig. 4-122) from power supply 1RE1PS1.

(2) Connect the unit under test as shown figure 4-123.

(3) Set the test facility switches as follo

Switch	Position	Normal indication
S1	ON	
S5	S2	
S2	26V UNREG	Meter M1 reads in green ba
		Peak-to-peak voltage of 120-Hz ripple, measured on the oscilloscope, should not exceed 600 mv.
S2	24V UNREG	Meter M1 reads in green ba

c. Voltage Regulator Amplifier 1RE1PS1A1

(1) Connect the test equipment as show n figure 4-124.

(2) Set test facility switch S2 to the 24V p- sition.

TM5820-540-35-20

Figure 4-109. Video amplifier 1RE1AR1AR1, printed circuit board.

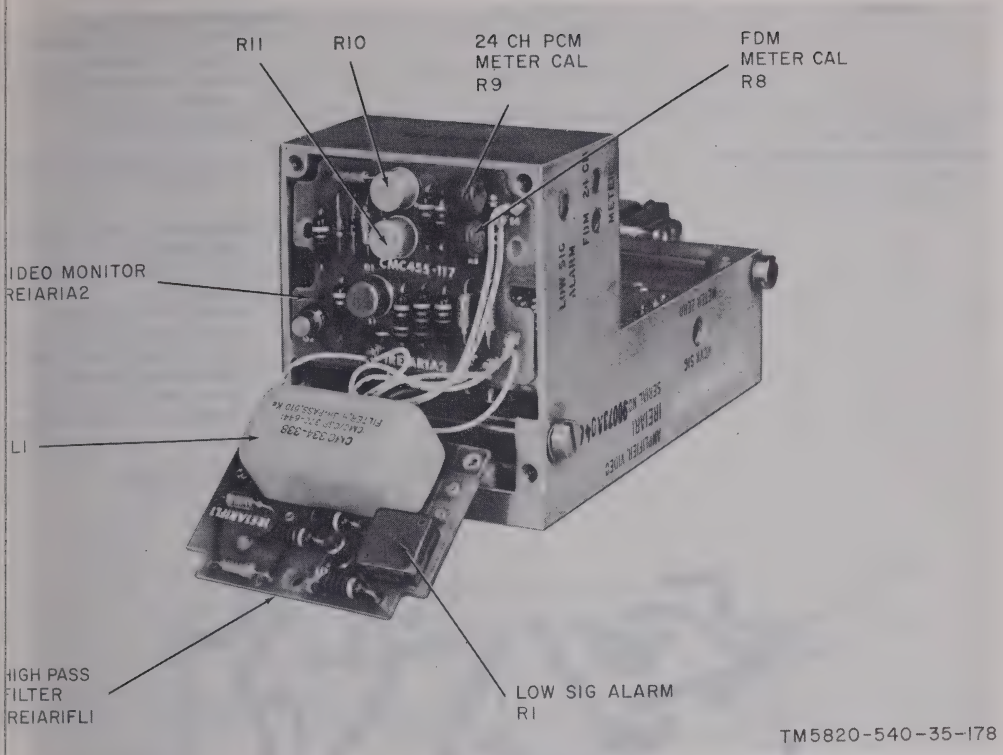


Figure 4-110. Video amplifier 1RE1AR1, side cover removed

(3) Adjust the power supply voltage control for 115v ac ±2v indicated on the multimeter. The facility meter M1 should indicate within the green band.

(4) Press and hold test facility switch S3. On the unit under test adjust R7 for 50 percent deflection (fig. 4–122) on meter M1 (center of green band).

(5) Release S3. Meter M1 should still indicate within the green band.

(6) Set switch S2 to position +12V. Press and hold switch S3. On the unit under test adjust R11 for 50 percent deflection on meter M1.

(7) Release S3. Meter M1 should still indicate within the green band.

(8) Set switch S2 to the METER +12V position. Press and hold switch S3.

(9) On the unit under test adjust R22 for 50 percent deflection on meter M1.

(10) Set switch S2 to the METER –12V position and adjust R19 on the module for 50 percent deflection on meter M1. Release S3.

(11) Set switch S2 to METER +12V. Press and hold S3. Adjust R5 for a minimum peak-to-peak ripple voltage. The ripple voltage observed on the oscilloscope should be less than 2 mv peak-to-peak.

(12) Set switch S2 to the METER –12V position. The ripple voltage observed on the oscilloscope should be less than 2 mv peak-to-peak. Readjust R5 if necessary.

(13) Set switch S2 to OFF.

(14) Seal potentiometers R5, R7, R11, R19, and R22 as described in paragraph 4–12.

(15) Install voltage regulator amplifier 1RE1PS1AR1 on power supply 1RE1PS1 chassis and test the complete units as described in paragraph 4–51.

Troubleshooting (fig. 6–28).

Symptom	Probable cause	Checks and corrective measures
bnormal indication with switch S2 in the 26V UNREG position.	*a.* Defective rectifier assembly A1 (fig. 4-121).	*a.* Check and replace A1 if necessary.

Symptom	Probable cause	Checks and corrective measures
	b. Defective diode CR1.	*b.* Check CR1 for shortcircuit, replace if necessary.
	c. Defective capacitor C1.	*c.* Check C1 for shortcircuit, replace if necessary.
Abnormal ripple measured at 26V UNREG position.	Capacitor C1 open.	Check and replace C1.
Abnormal meter indication with switch S2 on positions 24V, +12V and or −12V.	*a.* Rectifier assembly A2 or rectifier CR2 shorting.	*a.* Check and replace A2 or CR2 if necessary.
	b. Defective transistor Q1 or Q2 on heat sink.	*b.* Measure resistance of Q1 and Q2 (*e* below).
	c. C2 shorting or C4 open circuit.	*c.* Check C2 and C4. Replace as required.
	d. Defective voltage regulator amplifier.	*d.* Isolate the defective components by observing the voltage, and making resistance measurements shown in *e* below, and by checking the resistances of Zener diodes.

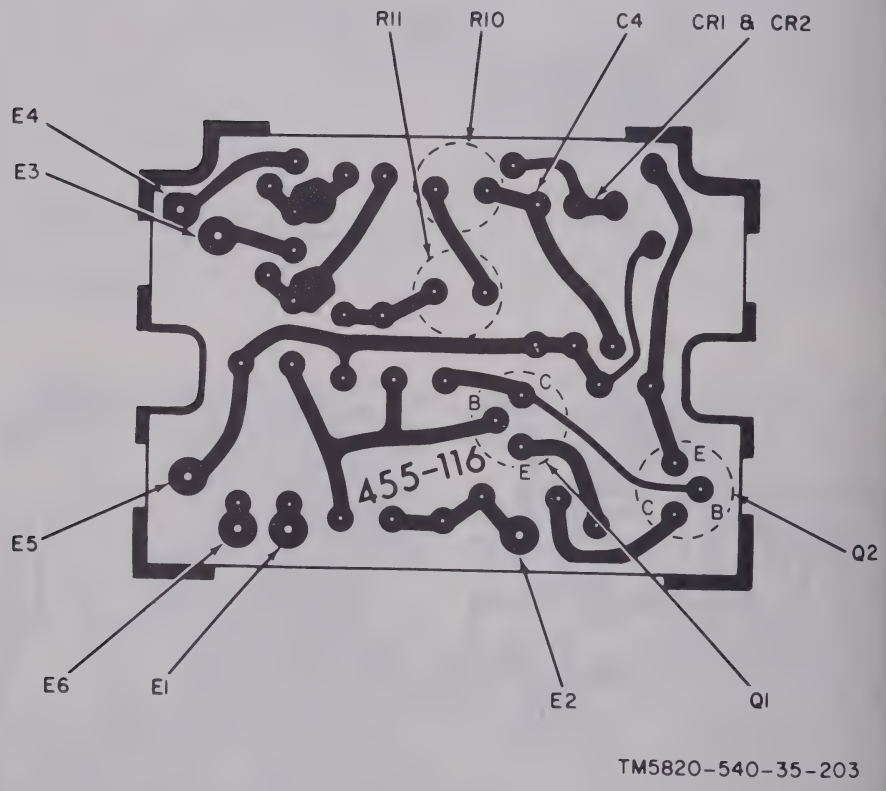


Figure 4-111. Video monitor 1RE1AR1A2, printed circuit board.

NOTE

All resistances measured with the allocated multimeter.

Module	Transistor		Base(−)				Base (+)			
			Emitter (+)		Collector (+)		Emitter (−)		Collector (−)	
	Ref.	Type	Res. (ohms)	Multimeter range	Res. (ohms)	Multimeter range	Res. (ohms)	Multimeter range	Res. (ohms)	Multimeter range
Voltage	Q1	2N697	3,000	x 100	20k	x 10,000	780	x 100	720	x 100
regulator	Q2	2N697	6,000	x 100	2,200	x 100	800	x 100	710	x 100
amplifier	Q3	2N697	1,900	x 100	2,400	x 100	780	x 100	710	x 100
1RE1PS1AR1	Q4	2N697	1,600	x 100	6,500	x 100	760	x 100	720	x 100
(fig. 4-125)	Q5	2N1132	920	x 100	900	x 100	2,000	x 100	5,500	x 100
	Q6	2N697	2,200	x 100	2,000	x 100	790			
Power	Q1	2N1490	3,000	x 100	20k	x 10,000	590	x 100	580	x 100
supply	Q2	2N1485	3,200	x 100	20k	x 10,000	580	x 100	570	x 100
1RE1PS1	Q3	2N1485	450	x 100	810	x 100	430	x 100	500	x 100
(heat sink	Q4	2N1484	460	x 100	4,000	x 100	440	x 100	500	x 100
assembly)										
(fig. 4-121)										

Note: Heat sink assembly readings obtained with voltage regulator amplifier connected.

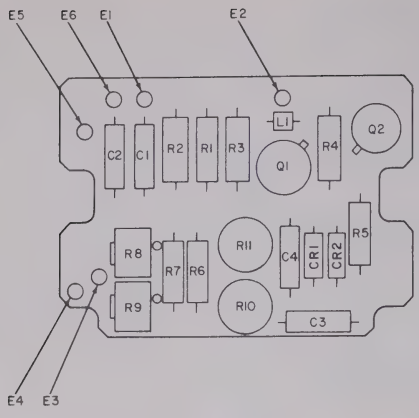


Figure 4-112. Video monitor 1RE1AR1A2, parts location.

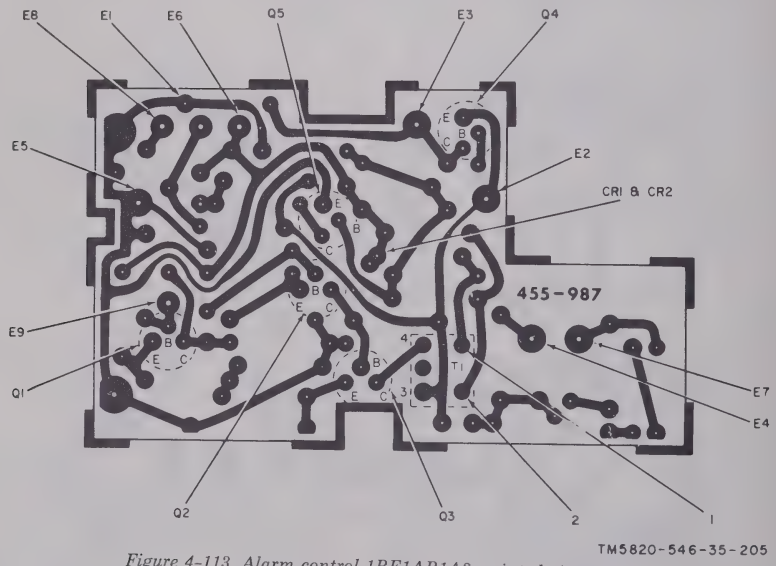


Figure 4-113. Alarm control 1RE1AR1A3, printed circuit board.

4-53. Receiver Case 1A2

NOTE

The following procedure checks the continuity and ground connections of the interconnecting cable between the receiver fixed head and the receiver rf head.

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Transmitter TS-2867(V)1/ GRM-95(V)	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit
Multimeter TS-352B/U	Multimeter
Extractor Tool, Cannon CET C6B	

b. Test Procedure—Continuity Check.

(1) Connect the test equipment as shown in figure 4-126.

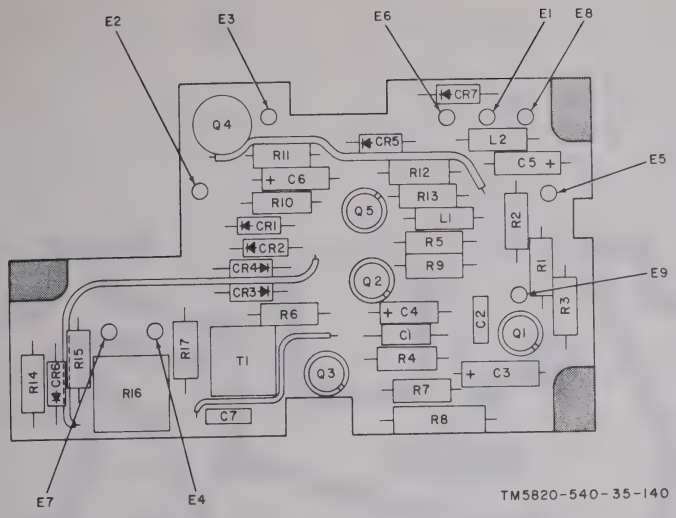


Figure 4-114. Alarm control 1RE1AR1A3, parts location.

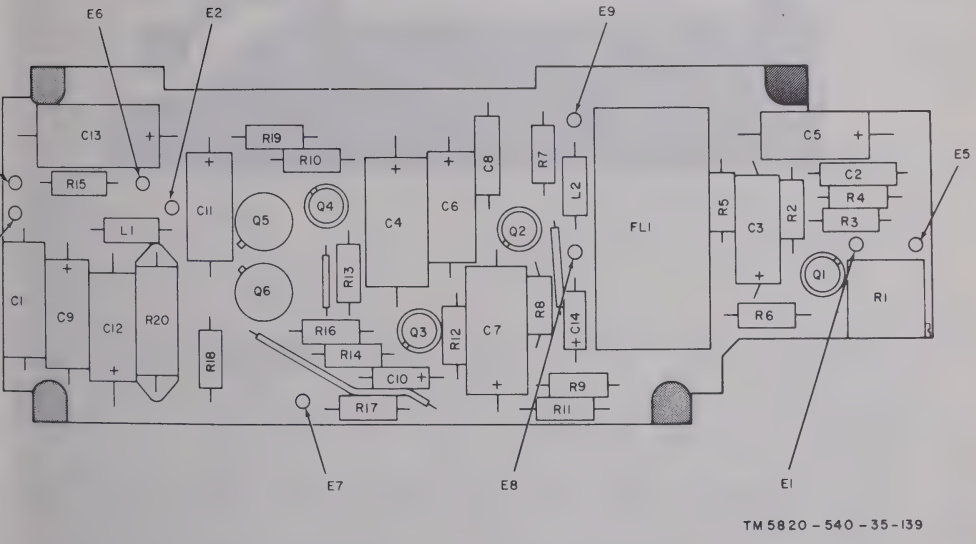


Figure 4-115. Video amplifier 1RE1AR1AR1, parts location.

) Set test facility switches S1 and S6 to ON.

) On the interconnecting box set switch positions 1 through 29 as shown in the chart

onnecting box switches 1	S2	Lamp lights with S2 in positions
1	1 thru 35	1, 30 thru 35
2	1 thru 35	2, 30 thru 35

Interconnecting box switches S1	S2	Lamp lights with S2 in positions
3	1 thru 35	3, 30 thru 35
4	1 thru 35	4, 30 thru 35
—	—	—
—	—	—
—	—	—
29	1 thru 35	29, 30 thru 35

(4) Set switch S2 to positions 30 through 35. The indicator lamp should light independently of the S1 switch position.

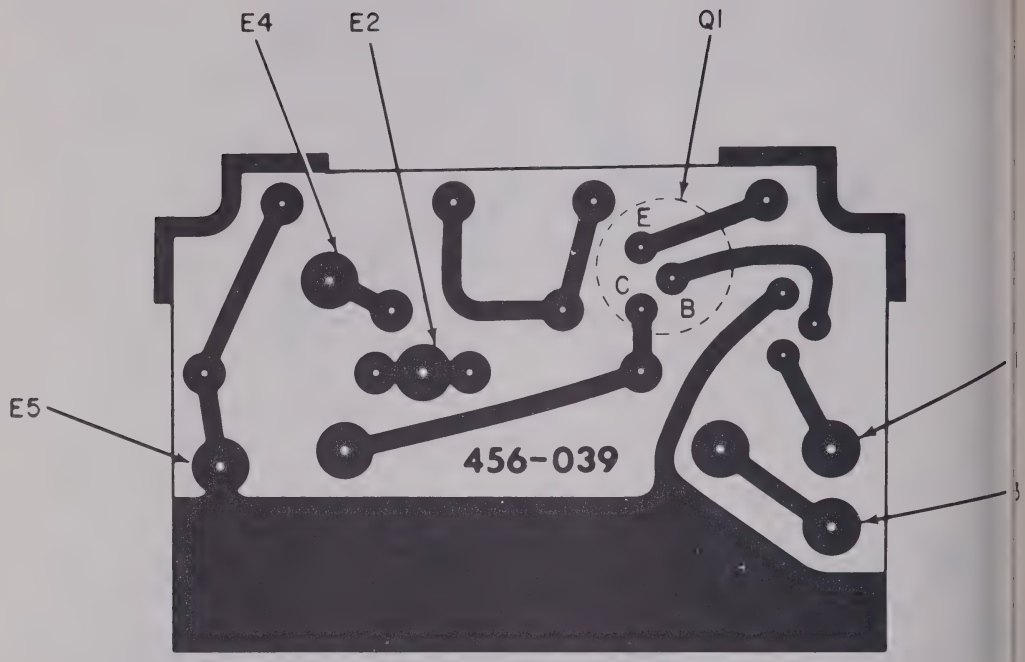


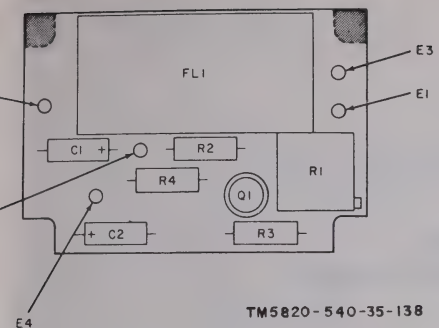
Figure 4-116. High pass filter 1RE1AR1FL1, printed circuit board.

(5) Refer to figure 6-29 and use the multimeter to check continuity of connectors 1A2A1J1 thru 1A2A1J7 to 1A2A1J9 and 1A2A1J10.

c. Repairs. If an abnormal indication is obtained in the tests above, remove the distribution box and cable assembly as described in paragraph 4-97. Repair or replace faulty connectors or wires. Refer to figure 6-29 and paragraph 4-10 for replacement of connectors. To remove rf connectors A1 and A2 of 1A2A1J9, extractor Cannon CET C6B is required.

4-54. Distribution Box 1A2A1

Refer to paragraph 4-53 to check continuity of distribution box 1A2A1. Replacement procedures are described in paragraph 4-97.



ure 4–117. High pass filter 1RE1AR1FL1, parts location.

Amplifier-Converter AM–4316/GRC–103(V)

est Equipment and Material Required.

Equipment	Common Name
Facility, Receiver 3-2867(V)1/ RM-95(V)	Receiver test facility
ssory Kit, Test acilities Set K-1173(V)1/ RM-95(V)	Accessory kit
meter, Electronic 3-30A/U	VTVM
erator, Signal N/USM-44A	Signal generator
nter, Electronic igital Readout N/USM-207	Counter
lloscope AN/USM-140	Oscilloscope
erator, Sweep gnal AN/USM-203	Sweep generator
meter AN/URM-98	Power meter
e Generator, erra 470A-500	Power signal source
meter, Digital N/GSM-64	Digital voltmeter

est Procedures.

) HIGH SIGNAL alarm and noise output

(*a*) Remove the dust cover from the unit tested. Connect the test equipment as in figure 4–127.

(*b*) Set the test facility switches as s:

Switch	Position
S1	ON
S5	S6
S7	AGC
S8	OFF
S6	MULTIPLIER

(*c*) Set the unit under test RCVR NNEL and RCVR SIG controls to channel 40 and the XMTR DUPL control to channel 70.

(*d*) Set the signal generator to 220 MHz at an output level of –60 dbm.

(*e*) Adjust the MULT PEAK and RCVR SIG controls on the unit under test for maximum indication on test facility meter M1.

(*f*) Increase the signal generator output level until the HIGH SIGNAL lamp lights on the test facility. The signal generator level should be between –15 dbm and +5 dbm. Note the level.

(*g*) Reduce the signal generator output level until the HIGH SIGNAL lamp goes out on the test facility. The signal generator level should be not more than 2 db below the level noted in (*f*) above.

(*h*) Repeat (*c*) through (*g*) above for the remaining channels listed in the chart that follows (3) below.

(*i*) Set up the equipment for testing at channel 409; refer to the chart that follows (3) below, and set signal generator output level to –74 dbm. **Disconnect the counter. Peak up all controls for minimum indication on the VTVM. Record the level indicated on the VTVM and calculate the noise figure of the unit under test.**

NOTE

The noise figure of the unit under test is calculated by subtracting the level indicated on the VTVM from a zero reference level of –54.6 dbm. *For example,* if the VTVM level is –46.6 dbm, then the noise figure is 54.6 minus 46.6 which is equal to 8 db. The noise figure should not exceed 8.75 db.

(*j*) Repeat (*i*) above for all remaining channels listed in the chart that follows (3) below.

(2) *Receiver protection switch leakage check.*

(*a*) Connect the test equipment as shown in figure 4–128.

(*b*) Adjust the signal generator to 220 MHz at an output of +5 dbm. Note the digital voltmeter indication.

(*c*) Repeat (*b*) above for the following frequencies: 240, 260, 280, 300, 320, 340, 360, 380, 404.5.

(*d*) Connect the test equipment as shown in figure 4–129. Set test facility switch S6 to REFL PWR.

(*e*) Set the RCVR CHANNEL and RCVR SIG controls to channel 40.

(*f*) Set the XMTR DUPL control to channel 70.

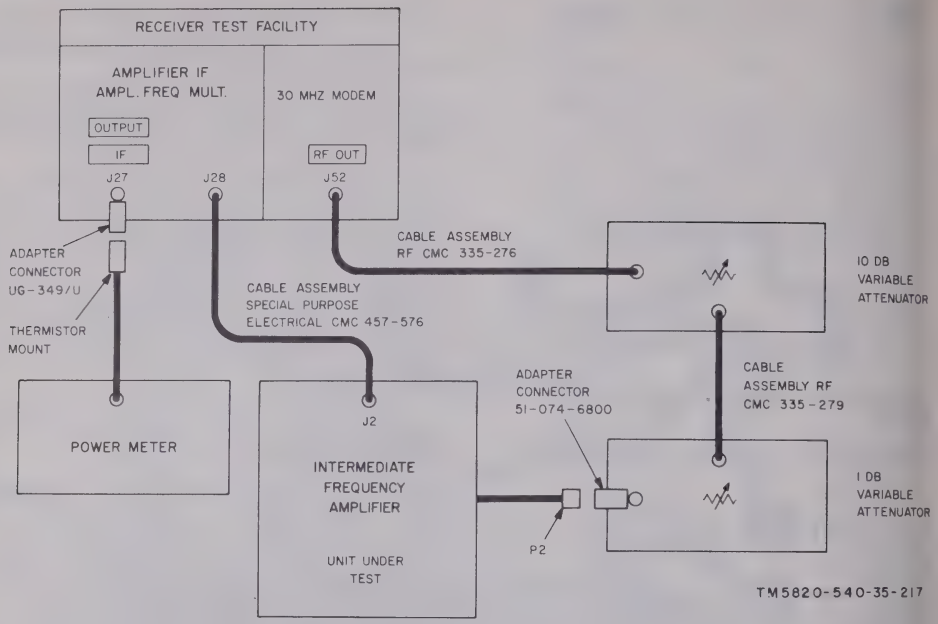


Figure 4-118. Intermediate frequency amplifier 1RE1AR2, test set-up.

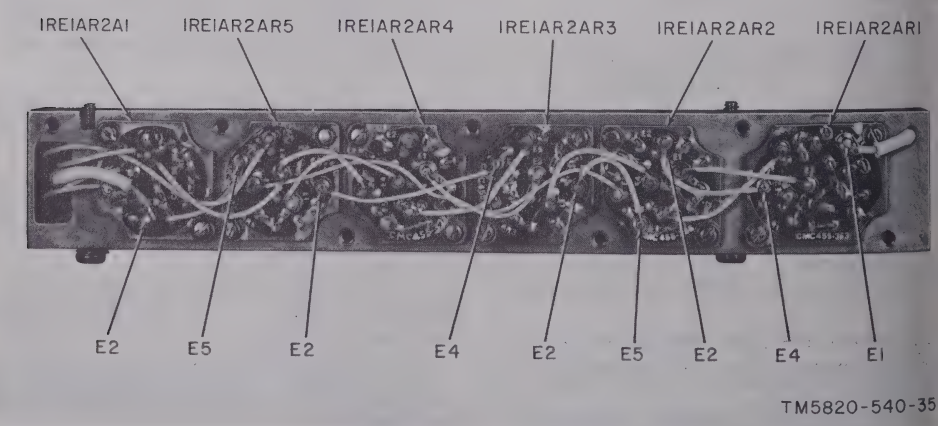


Figure 4-119. Intermediate frequency amplifier 1RE1AR2, cover removed.

(*g*) Set the power signal source frequency to 270 MHz and switch on the power signal source.

(*h*) Slowly adjust the power signal source to 220 MHz and raise the output level to 50 watts while observing the digital voltmeter indication and the HIGH SIGNAL alarm lamp on the test facility. The lamp should light when the frequency of the power signal source approaches the frequency of the receiver channel. The digital voltmeter indication should not exceed the value noted in (*b*) above. Test facility meter M1 should

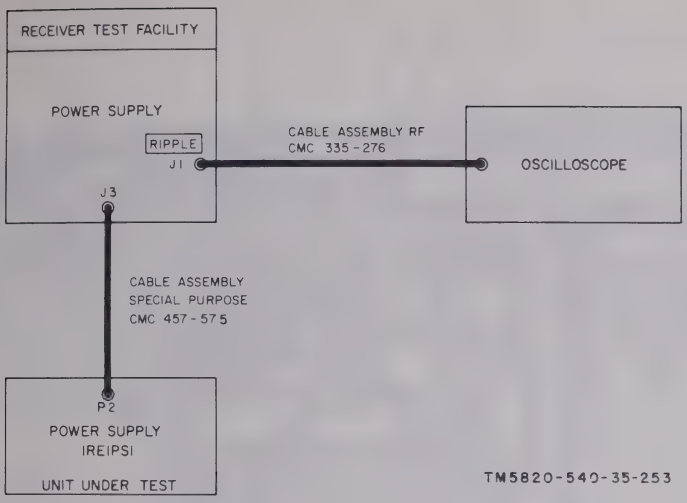


Figure 4-120. Power supply 1RE1PS1, (overall) test set-up.

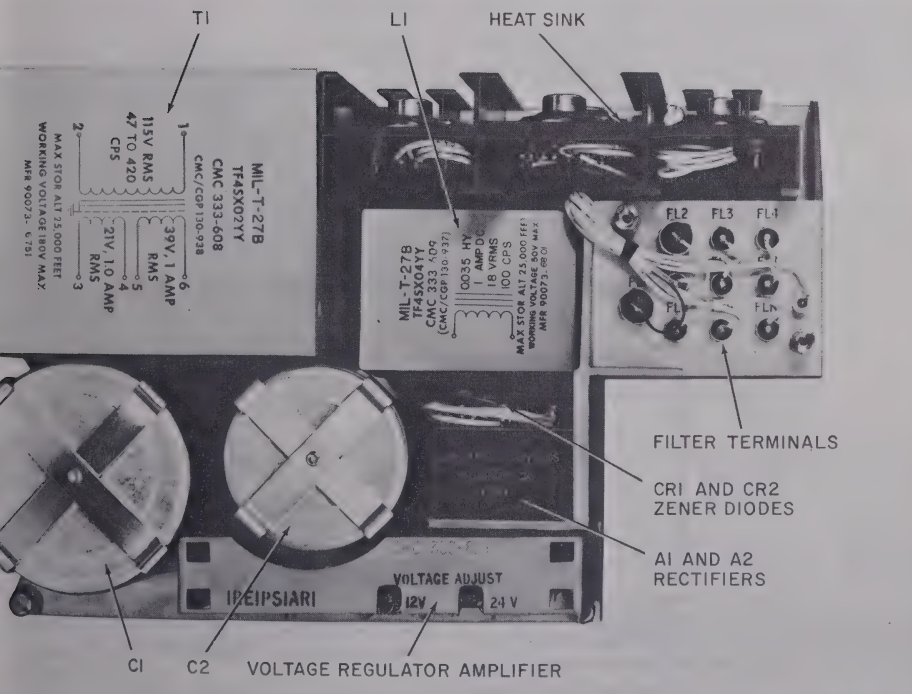


Figure 4-121. Power supply 1RE1PS1, top view.

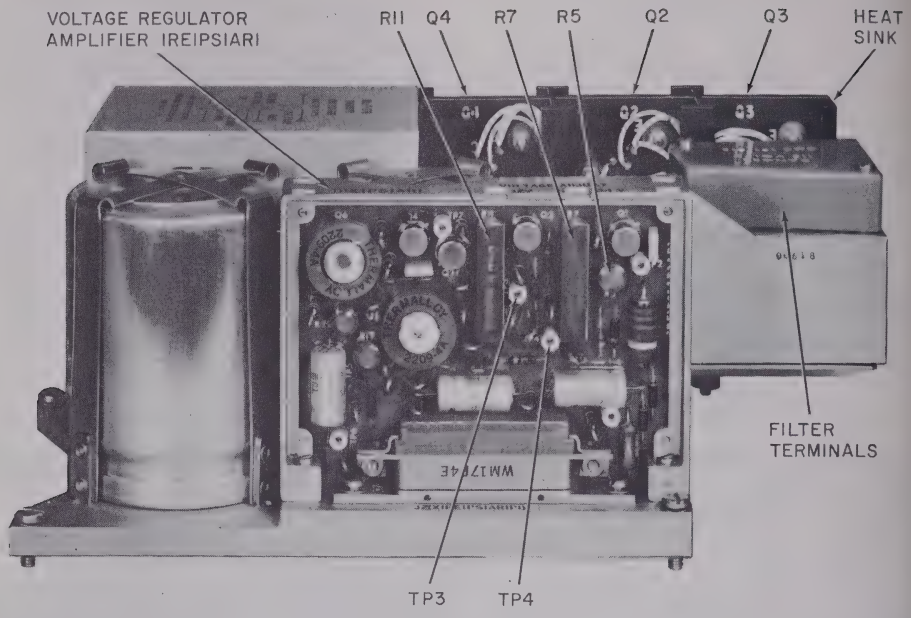


Figure 4-122. Power supply 1RE1PS1, side view.

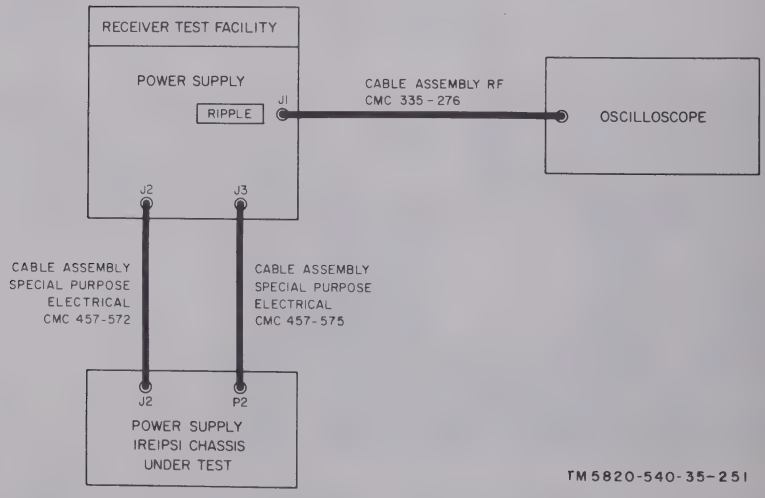


Figure 4-123. Power supply 1RE1PS1, (chassis), test set-up.

indicate approximately 100 percent of full scale deflection.

(*i*) Switch the power signal sour and on again immediately. The digital vol

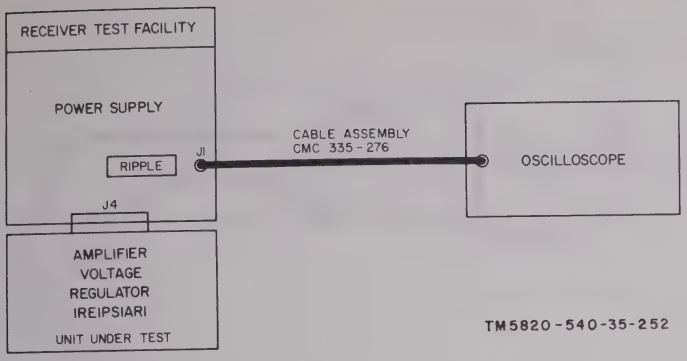


Figure 4-124. Voltage regulator amplifier 1RE1PS1AR1, test set-up.

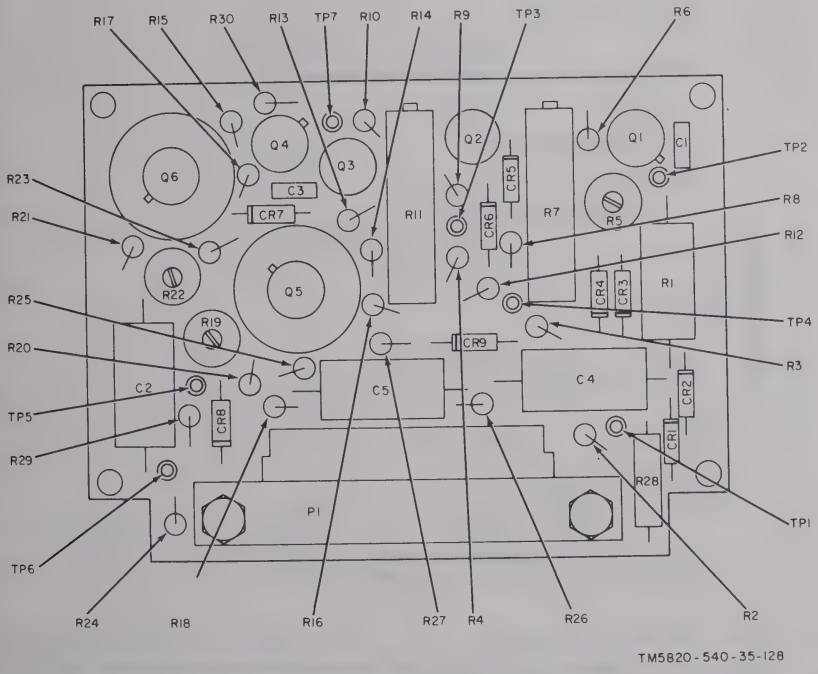


Figure 4-125. Voltage regulator amplifier 1RE1PS1AR1AR1, parts location.

on should not exceed the value noted in ve.

(*j*) Repeat (*d*) through (*i*) above for all ng channels listed in the chart that fol-) below.

(*k*) Switch off the power signal source.

(*l*) Reverse the connections at the ANT. ROM QMTR connectors of the unit under

(*m*) Set test facility switch S6 to XMTR PWR.

(*n*) Set the power signal source frequency to 235 MHz and on unit under test, set the RCVR SIG control to channel 40 and the XMTR DUPL control to channel 70.

(*o*) Switch on the power signal source and observe test facility meter M1. The indication should be approximately 100 percent of full scale.

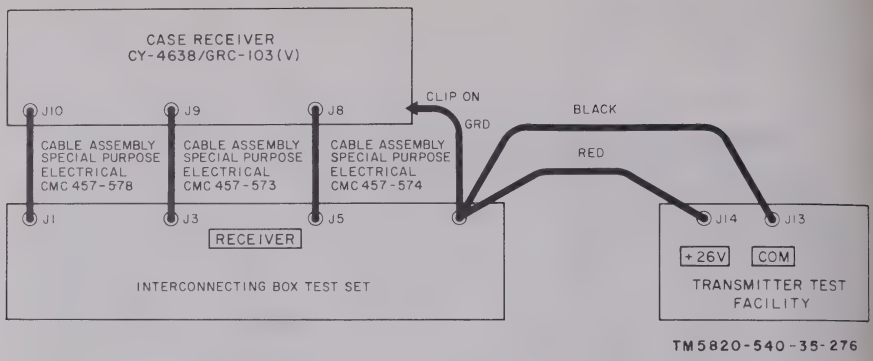


Figure 4-126. Receiver case continuity check, test set-up.

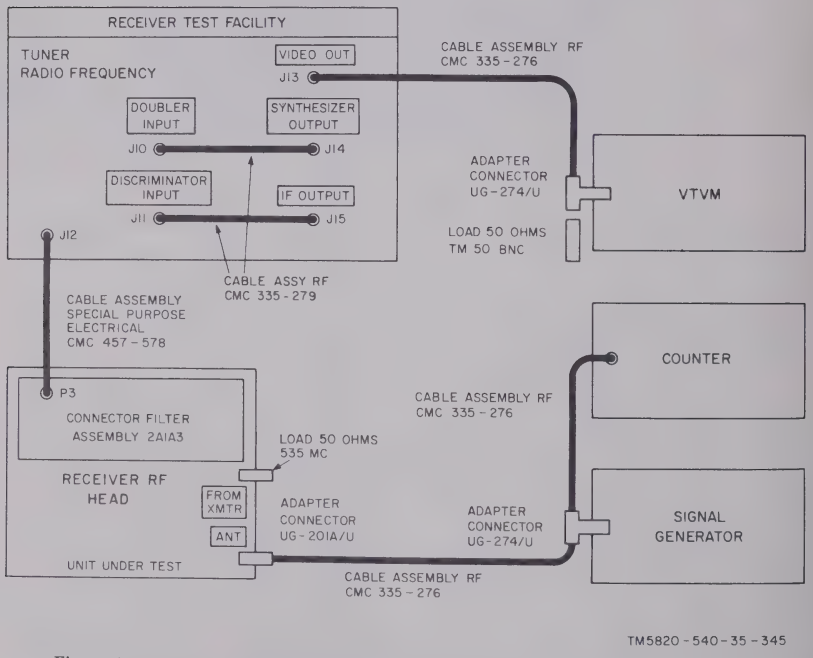


Figure 4-127. Receiver rf head, HIGH SIGNAL alarm and noise output check, test set-up

(*p*) Repeat (*c*) through (*i*) of the noise output test ((1) above) for any one receiver channel listed in the chart that follows (3) below. Check that noise output does not exceed previously recorded value.

(3) *Input vswr check.*

(*a*) Connect the equipment as shown in figure 4–130A.

(*b*) Adjust the sweep generator controls for a flat output over the frequency range 220 to 405 MHz.

(*c*) Connect the power meter to the r
put of the sweep generator (fig. 4–130B).

(*d*) Set the sweep generator to CW a
adjust the rf attenuator for a power meter
cation of –15 dbm.

(*e*) Set the sweep generator to SW
and reconnect its rf output to the bidirec
coupler (fig. 4–130A).

(*f*) Set test facility switch S4 to O

(*g*) Connect the 1–2.50F calibrated
match to the bidirectional coupler (fig. 4–1

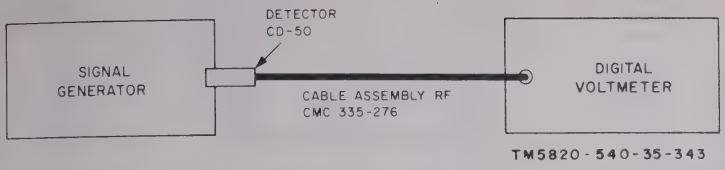


Figure 4-128. Equipment calibration test set-up.

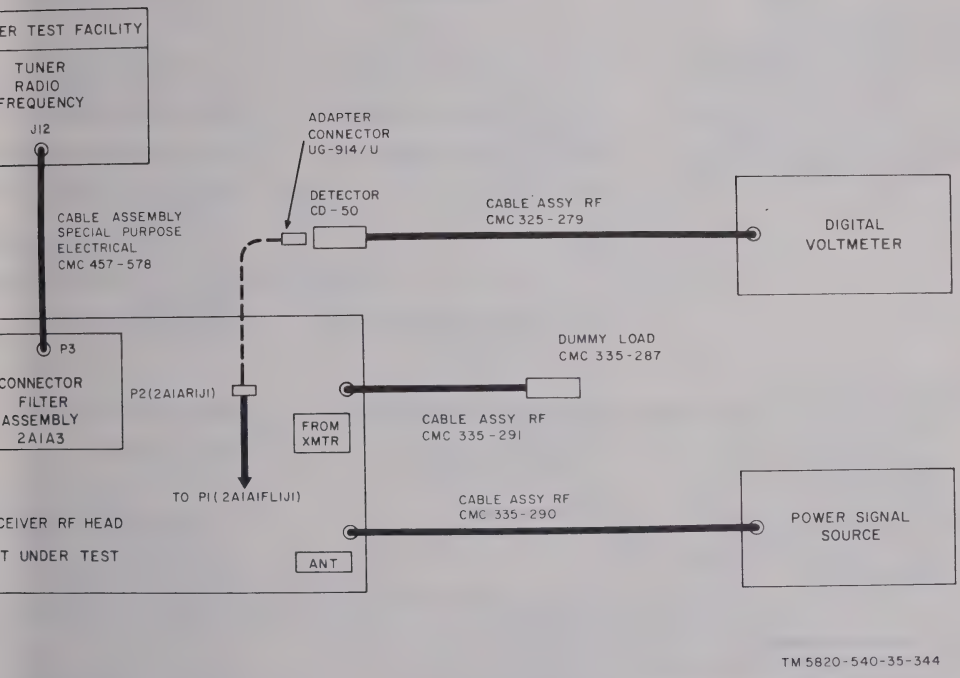


Figure 4-129. Receiver rf head, receiver protection switch check, test set-up.

just the oscilloscope controls for a con- t display of the vswr curve. *For example,* seline of the display on the top line of the scope graticule and the vswr curve on the line of the graticule. Record the resultant urve between 220 MHz and 405 MHz.

(*h*) Connect equipment as shown in 4-130C.

(*i*) Set the unit under test and the signal tor to the first channel frequency shown in art below. The vswr curve displayed on the oscilloscope should not exceed the 2.5 calibration mark, with a minimum vswr bandwidth of 2 MHz and a maximum vswr bandwidth of 7.0 MHz.

NOTE

At channel 40 a minimum vswr bandwidth of 1.8 MHz is permissible.

(*j*) Repeat (*i*) above for the remaining channels listed below.

Signal RCVR CHANNEL and RCVR SIG channel settings	generator (receiver) frequency	XMTR DUPL channel setting	Signal RCVR CHANNEL and RCVR SIG channel settings	generator (receiver) frequency	XMTR DU channel set
40	220	70	240	320	210
80	240	110	280	340	250
120	260	150	320	360	290
160	280	190	360	380	330
200	300	230	409	404.5	379

c. Troubleshooting

Note. This troubleshooting chart is supplemented by the troubleshooting charts contained in chapter 3 of this manual and in TM 11–5820–540–12.

Symptom	Probable cause	Checks and corrective measu
Step 1 of test procedure		
Step 1 of test procedure.		
High signal alarm operates outside specified limits.	Defective electronic switch 2A4 (fig. 3-18).	Test as described in para 4-66.
Noise figure exceeds 8.75 db at one or more frequencies.	Defective radio frequency tuner 2A1 (fig. 6-18).	Test as described in para 4-56.
Test facility meter M1 indication (MULTIPLIER) below normal.	Defective control-indicator 2A2 (fig. 3-18).	Test as described in para 4-32.
	Defective wiring.	Check continuity between 2A1W and 2A1A3P3. Check continuity of metering cir cuit between pin 4 of J2 (X2A1A2A1P1) and pin 24 o 2A1A3P3.
	Defective frequency mixer stage 2A1A2A2 (fig. 3-18).	Check metering circuit of 2A1A2A2 as described in para 4-61.
Step 2 of test procedure.		
VTVM indication exceeds the +5-dbm calibration level at one or more frequencies with high power applied to unit under test.	Defective electronic switch 2A4 (fig. 3-18).	Test as described in para 4-66.
	Defective power supply 2PS1 (fig. 3-16).	Test as described in para 4-67.
Indication on test facility meter M1 low or zero when S6 at REFL PWR position or XMTR PWR position.	Defective wiring.	Check continuity from pin 1 of 2A1W4J2 to pin 25 of 2A1A3 and from pin 3 of 2A1W4J2 to pin 26 of 2A1A3P3.
	Defective power monitor 2A1A5 (fig. 3-16).	Replace 2A1A5. Refer to para 3 for replacement procedures.
Step 3 of test procedure.		
Input vswr exceeds 2.5 at one or more frequencies.	Defective radio frequency tuner 2A1 (fig. 6-18).	Check input vswr at J1 of impedance matching network 2A1A1Z1 para 4-56).
	Defective power monitor 2A1A5 (fig. 3-16).	If above vswr check is normal check that connectors J1 (A and P2 (XA1A1Z1J1) are not damaged. If connectors are undamaged, re power monitor 2A1A5 as des in para 3-60.

Note. Any remaining faults should be due to defective wiring. Check the wiring, using the interconnecting diagram and the multimeter.

4–56. Radio Frequency Tuner 2A1

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility Receiver TS-2867(V)1/ GRM-95(V)	Receiver test facility
Accessory Kit, Test Facilities Set	Accessory kit
MK-1173(V)1/ GRM-(V)	
Voltmeter Electronic ME-30A/U	VTVM
Generator, Sweep Signal AN/USM-203	Sweep generator
Generator, Signal AN/USM-44A	Signal generator
Oscilloscope AN/USM-140	Oscilloscope
Wattmeter AN/URM-98	Power meter

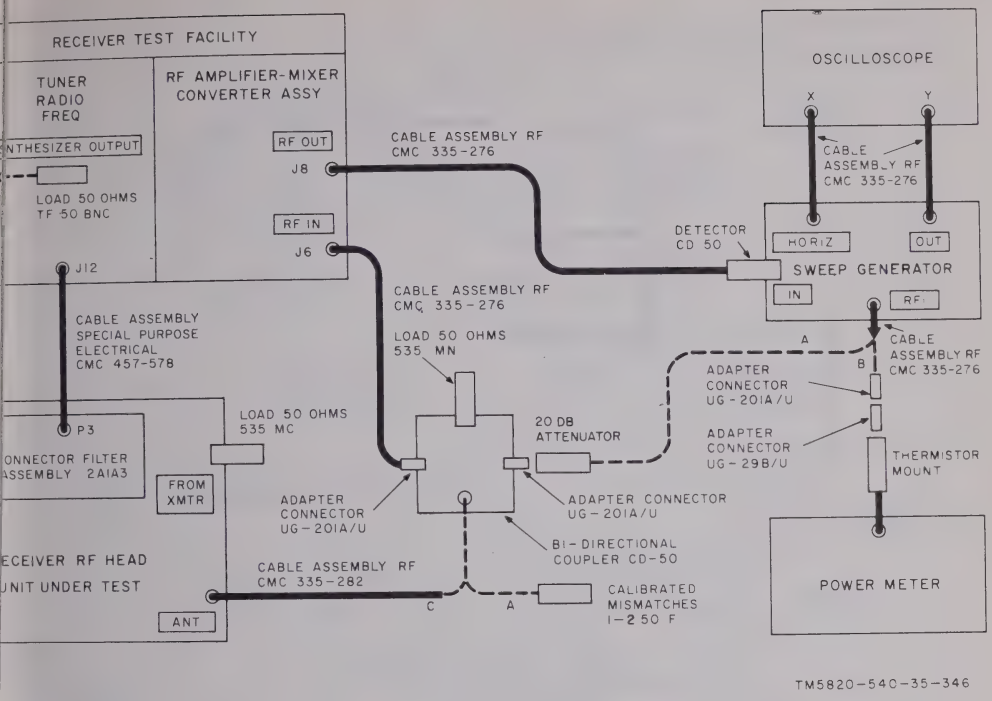


Figure 4-130. Receiver rf head, input vswr check, test set-up.

est Procedures.

NOTE

ing the following tests, be sure that the TR DUPL control is adjusted at least 50 nnels from the setting of the RCVR SIG rol.

.) *Operational check.*

(*a*) Connect the test equipment as shown ure 4–131A.

(*b*) On the unit under test, set the CHANNEL and RCVR SIG controls to el 200 and the XMTR DUPL control to el 40.

(*c*) Tune the signal generator to 300.0 at a level of –74 dbm.

(*d*) Set the test facility switches as fol-

itch	Position	Normal indication on meter M1
31	ON	
35	S6	
37	AGC	
36	REFL PWR	0
	XMTR PWR	0
	OSC	20% to 90% full scale
	DBLR	20% to 90% full scale
	REC SIG	20% to 90% full scale
	24 CHAN	0
	FDM	0

(*e*) Set switch S6 to MULTIPLIER and adjust MULT PEAK control on the unit under test for maximum indication on test facility meter M1. The indication should be between 20 and 90 percent.

(*f*) The VTVM should indicate less than –46.6 dbm. This corresponds to a noise factor of 8 db.

(*g*) Set switch S6 to REC SIG position. Meter M1 should indicate between 20 and 90 percent full scale.

(2) *Duplexer transmit path check.*

(*a*) Connect the test equipment as shown in figure 4–132.

(*b*) On the unit under test, set the XMTR DUPL control to channel 200 and the RCVR SIG and RCVR CHANNEL controls to channel 40.

(*c*) Set the signal generator level to –10 dbm at 300 MH.

(*d*) The power meter should indicate at least –11.5 dbm.

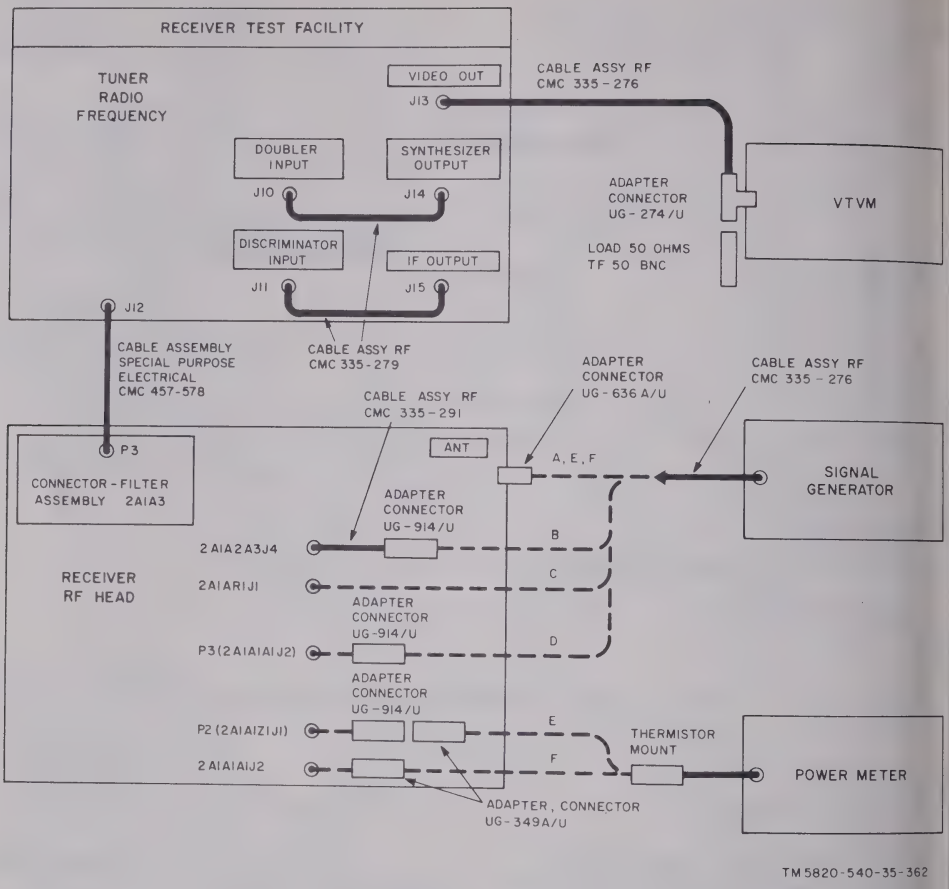


Figure 4-131. Radio frequency turner 2A1 operational check test set-up.

(3) *Duplexer receive filter-local oscillator filter tracking.*

(*a*) Connect the test equipment as shown in figure 4–133.

(*b*) Set the coaxial switch to position 1 to display the rf signal path response on the oscilloscope.

(*c*) On the unit under test set RCVR SIG and RCVR CHANNEL control to channel 410.

(*d*) Tune the sweep generator and the oscilloscope vertical sensitivity control until the receiver bandpass filter response is displayed on the oscilloscope.

(*e*) Use the sweep generator markers and the RCVR SIG control on the front panel of the unit under test to set the maximum amplitude of the response precisely on 405 MHz.

(*f*) Set the coaxial switch to position 2 t display the local oscillator path response o oscilloscope.

(*g*) On the unit under test set th MULT PEAK control to its fully clockwise os tion to tune the response at its highest fre cy, which should be at least 440 MHz.

NOTE

If the 440–MHz limit is not met, locate the clam holding the spur gear connecting the local osc lator drive mechanism in the unit under test, shown in fig. 4–134. Loosen the clamp and rota the gear until 440 MHz as described in (*g*) abo is reached. Lock the setscrew to tighten th clamp.

(*h*) Set the MULT PEAK control o the unit under test to its fully counterclockwise os

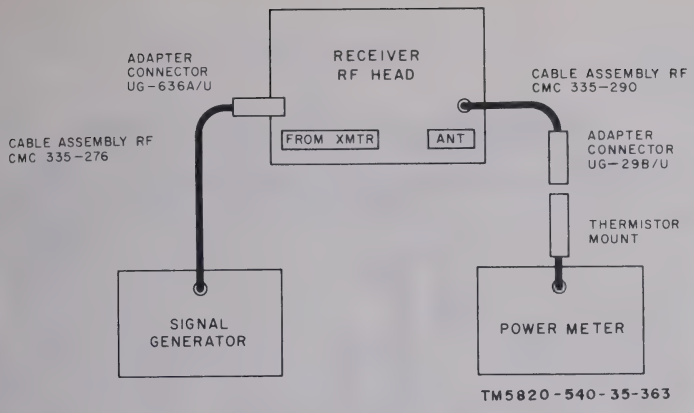


Figure 4-132. Radio frequency tuner 2A1, transmit path, operational check test set-up.

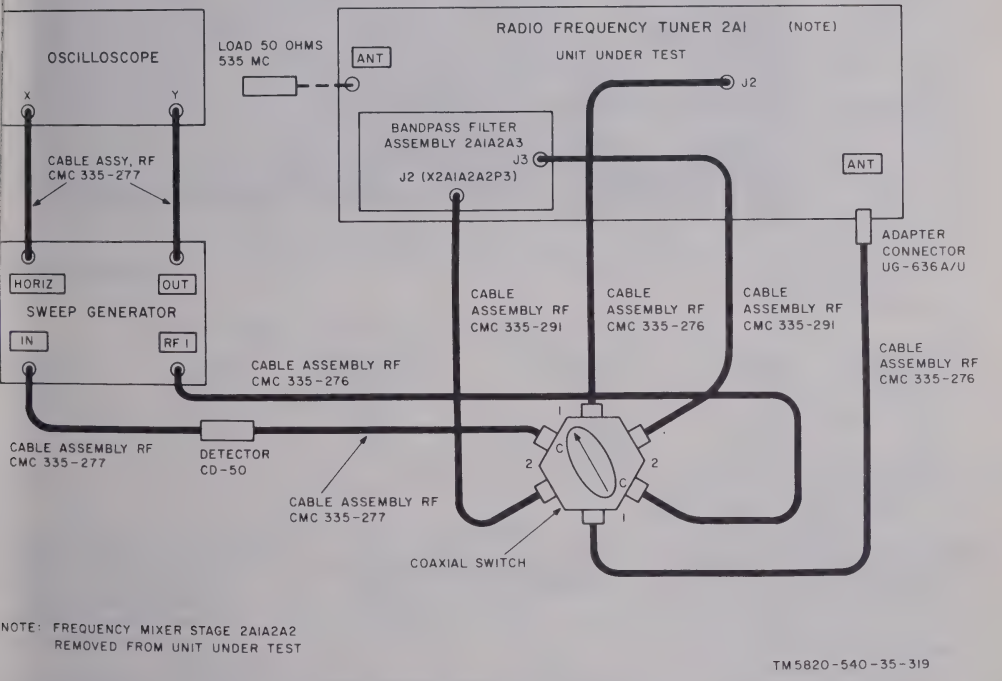


Figure 4-133. Radio frequency tuner 2A1, duplexer receive filter-local oscillator filter tracking.

The resonant frequency of the response be at least as low as 425 MHz.

NOTE

MULT PEAK control on the unit under should be able to vary the local oscillator frequency at least over the range of 27 MHz 33 MHz above the signal path frequency. Adjust the gear shown in fig. 4-134 until the track- is within specifications in all cases.

(*i*) Repeat (*b*) through (*h*) above for the remaining channels shown in the chart below, starting with channel 40.

NOTE

When setting the RCVR SIG control, approach the designated channel carefully to insure that this control is rotated only in the counterclockwise direction.

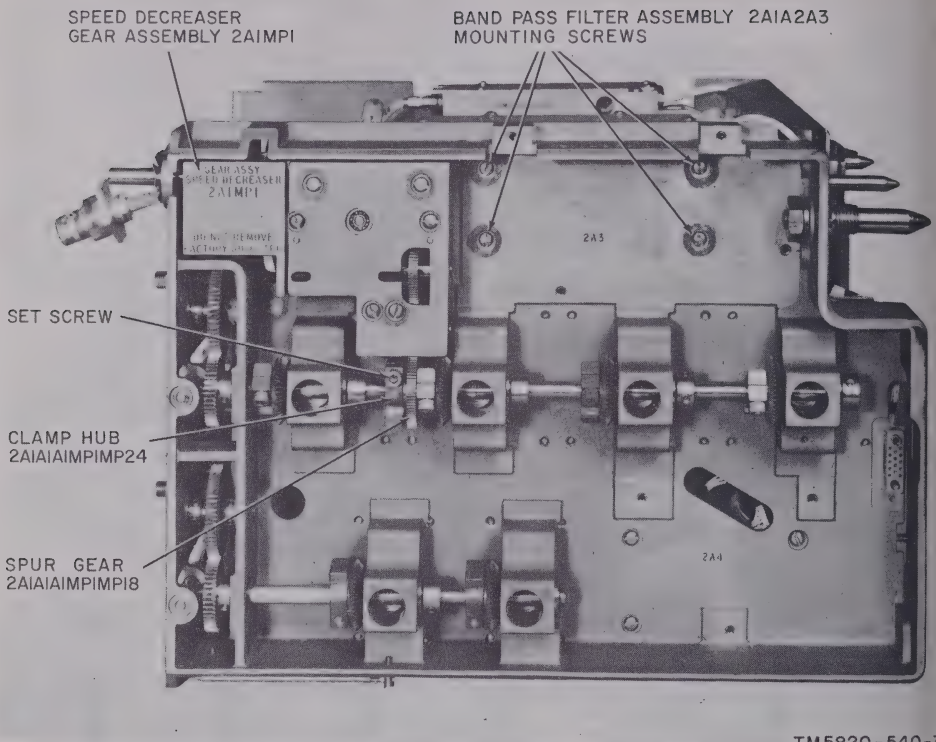


Figure 4-134. Receiver rf head, front cover removed, bottom and left side view.

RCVR SIG and RCVR CHANNEL setting	Receiver frequency (MHz)	Local oscillator response (MHz)	RCVR SIG and RCVR CHANNEL setting	Receiver frequency (MHz)	Local oscillator response (MHz)
410	405	425-440	100	250	277-283
300	350	377-383	40	220	247-253
200	300	327-333			

c. Troubleshooting (fig. 6–18).

Symptom	Probable cause	Checks and corrective measures
MULTIPLIER reading abnormal and high noise level at J13 VIDEO OUT.	Receiver channel indicator tape sticking.	1. Set switch S6 to OFF. Check to see that the tape moves freely in both directions. If tape is struck or erratic, follow procedure described in para 4-103.
	Defective mechanical linkage between RCVR SIG control and speed decreaser assembly.	2. Operate the RCVR SIG control clockwise and counterclockwise at least eight turns. If the MULT PEAK control does not turn with the RCVR SIG control after eight turns refer to para 4-56.
	Tape does not track.	3. With the RCVR SIG and MULT PEAK controls maximum counterclockwise, slowly turn the RCVR SIG control clockwise until meter M1 indicates between 20 and 90 percent full-

Symptom	Probable cause	Checks and corrective measures
		scale. Peak the indication with MULT PEAK control. If the tape display does not indicate channel 200, refer to para 4-57.
	Defective electronic frequency converter 2A1A2.	4. If no peak can be found in 3 above carry out checks and tests described in para 4-59.
g noise level on VTVM at dB and REC SIG meter indi-ces between 20% and 90%.	Electronic frequency converter 2A1A2.	5. (a) Connect test equipment as shown in fig. 4-131B. (b) Set signal generator to 300 MHz at a level of −50 dbm. (c) If noise level is more than −46.6 dbm and REC SIG meter indication is still abnormal, refer to para 4-59.
	Defective rf amplifier 2A1AR1.	6. (a) Connect test equipment as in fig. 4-131C. (b) Set signal generator to 300 MHz at a level of −74 dbm. (c) If noise level and REC SIG indication are abnormal, refer to para 4-64.
	Defective electronic switch 2A4. (fig. 3-18)	7. (a) Connect test equipment as in fig. 4-131D. (b) Set signal generator to 300 MHz at a level of −74 dbm. (c) The noise level must be less than 0.75 dbm higher than in 6(*c*) above. If the noise level is higher, refer to para 4-66.
	Defective duplexer 2A1A1.	8. (a) Connect test equipment as in figure 4-131F. (b) Set signal generator to 300 MHz at a level of −10 dbm. (c) Peak for maximum power meter indication using RCVR SIG control. (d) If level is less than −12.0 dbm refer to para 4-57.
	Tracking between duplexer 2A1A1 and electronic frequency converter 2A1A2 abnormal.	9. (a) Connect test equipment as in fig. 4-131A. (b) Follow the procedure in *b* (1) above up to step (*d*). (c) Follow receiver signal local oscillator tracking procedure as described in para 4-56 *b*(3).
	Defective power monitor 2A1A5.	10. (a) Connect test equipment as shown in fig. 4-141E. (b) Set signal generator to 300 MHz at −10 dbm. (c) If power meter indicates less than −10.5 dbm follow procedure described in para 3-23.
	High transmit path insertion loss.	11. Refer to test and troubleshooting procedures described in para 4-57 and 4-58.

4–57. Duplexer 2A1A1

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Receiver TS-2866(V)1/ GRM-95(V)	Receiver Test Facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory Kit
Adapter-connector 636A/U	—
Generator, Sweep Signal AN/USM-203	Sweep Generator
RF Cable Assembly, CMC 217-800013 (fig. 5-18)	
Oscilloscope AN/USM-140	Oscilloscope

b. Test Procedures.

NOTE

During the following tests, be sure that the XMTR DUPL control is adjusted to at least 50 channels from the setting of the RCVR SIG control.

(1) *Receive path inserting loss measurement.*

(*a*) Connect the test equipment as shown in fig. 4–135A.

(*b*) Set the variable attenuators to zero.

(*c*) On the unit under test set the RCVR SIG control to channel 410 and the XMTR DUPL control to channel 40.

(*d*) Tune the sweep generator until the receiver bandpass filter response is displayed on the oscilloscope.

(*e*) On the oscilloscope adjust the vertical sensitivity control to bring the peak amplitude of the response to a convenient level. Mark the position of the response level on graticule.

(*f*) On the unit under test disconnect the cables from P2 (2A1AR1J1) and ANT. connectors and connect them together (fig. 4–135C).

(*g*) Adjust the variable attenuators until the initial level, as set in (*e*) above, is reached. Note the attenuator settings; the insertion loss should not be more than 2 db.

(*h*) On the unit under test reconnect the cables to the P2 (2A1AR1J1) and ANT. connectors.

(*i*) Set the RCVR CHANNEL control to channel 225 and repeat (*b*) through (*h*) above.

(*j*) Set the RCVR SIG control to channel 40 and the XMTR DUPL control to channel 225 and repeat (*b*) through (*h*) above.

(2) *Receive path linearity measurem*

(*a*) Connect the test equipment as sh in figure 4–135A.

(*b*) On the unit under test set the R SIG control to channel 410 and XMTR D control to channel 380.

(*c*) Set the variable attenuators to

(*d*) Tune the sweep generator until th ceiver bandpass filter response is displayed o oscilloscope.

(*e*) On the oscilloscope adjust the ve sensitivity control to bring the peak amplitu the response to a convenient level.

(*f*) With the aid of the 1 MHz ma from the sweep generator, determine the a tude of the response at ± MHz from the amplitude.

(*g*) Slowly vary the variable attenu to reduce the peak amplitude to the level o lowest of the ± 1 MHz points. The receive ripple as indicated by the variable attenuato tings should be not greater than 0.5 db.

(*h*) Repeat (*b*) through (*g*) above every 50 channels down to channel 40 (ref the Note above).

(3) *Transmit path insertion loss mea ments.*

(*a*) Connect the test equipment as sh in figure 4–135B.

(*b*) Set the variable attenuators to zer

(*c*) On the unit under test set the XMTR DUPL control to channel 410 and the RCVR SIG control to channel 40.

(*d*) Tune the sweep generator unti transmitter bandpass filter response is disp on the oscilloscope.

(*e*) On the oscilloscope adjust the ve sensitivity control to bring the peak ampl of the response to a convenient level. Mar position of the response level on the graticu

(*f*) Disconnect, from the unit under the cables from the FROM XMTR and ANT. nectors and connect them together with a sui adapter.

(*g*) Adjust the variable attenuators the initial level as set in (*e*) above is rea Note the attenuator settings; the insertion should not be more than 1.5 db.

(*h*) On the unit under test reconnec cables to the FROM XMTR and ANT. co tors.

(*i*) Set the XMTR DUPL control to nel 225 and repeat (*b*) through (*h*) abov

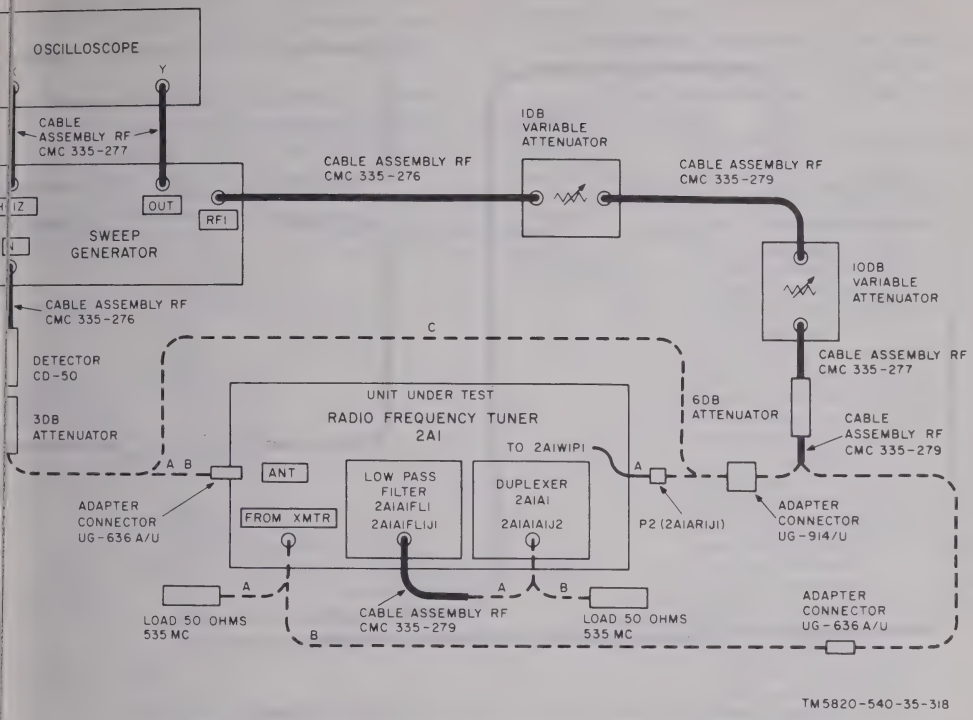


Figure 4-135. Duplexer 2A1A1, receive and transmit-path test set-up.

(*j*) Set the XMTR DUPL control to chan- and the RCVR SIG control to channel 225 epeat (*b*) through (*h*) above.

) *Transmit path linearity measurements.*

(*a*) Connect the test equipment as shown re 4–135B.

(*b*) On the unit under test set the XMTR control to channel 410 and the RCVR ntrol to channel 380.

(*c*) Set the variable attenuators to zero.

(*d*) Tune the sweep generator until the itter bandpass filter response is displayed oscilloscope.

(*e*) On the oscilloscope adjust the vertical vity control to bring the peak amplitude of sponse to a convenient level.

(*f*) With the aid of the 1 MHz markers he sweep generator, determine the ampli- f the response at ±1 MHz from the peak ude.

(*g*) Slowly vary the variable attenuators to the peak amplitude to the level of the of the 1 MHz response points. Note the it path ripple as indicated by the vari- ttenuator settings; it should be not r than 0.5 db.

(*h*) Repeat (*b*) through (*g*) above for every 50 channels down to channel 40 (refer to the Note above).

(5) *Vswr measurements.*

(*a*) *Transmitter filter.*

1. Connect the equipment as shown in figure 4–136A.

2. Calibrate the oscilloscope for a vswr of 2.0 over the frequency range of 220 to 405 MHz.

3. Set sweep generator SWEEP dial to 405 MHz.

4. Disconnect the mismatch from Z2 of the vswr detector and connect J1 (2A1A1Z1) to Z2 (fig. 4–136B).

5. Set the RCVR SIG control fully counterclockwise and the XMTR DUPL control to channel 410. With the aid of the markers check to see that the transmit filter is tuned to 405 MHz. The vswr displayed should be less than 2.0.

6. Check to see that the bandwidth of the display is between 2 to 7 MHz.

7. Tune the sweep generator through to 220 MHz and simultaneously tune XMTR DUPL control through to channel 40. The vswr displayed on the oscilloscope should be less than

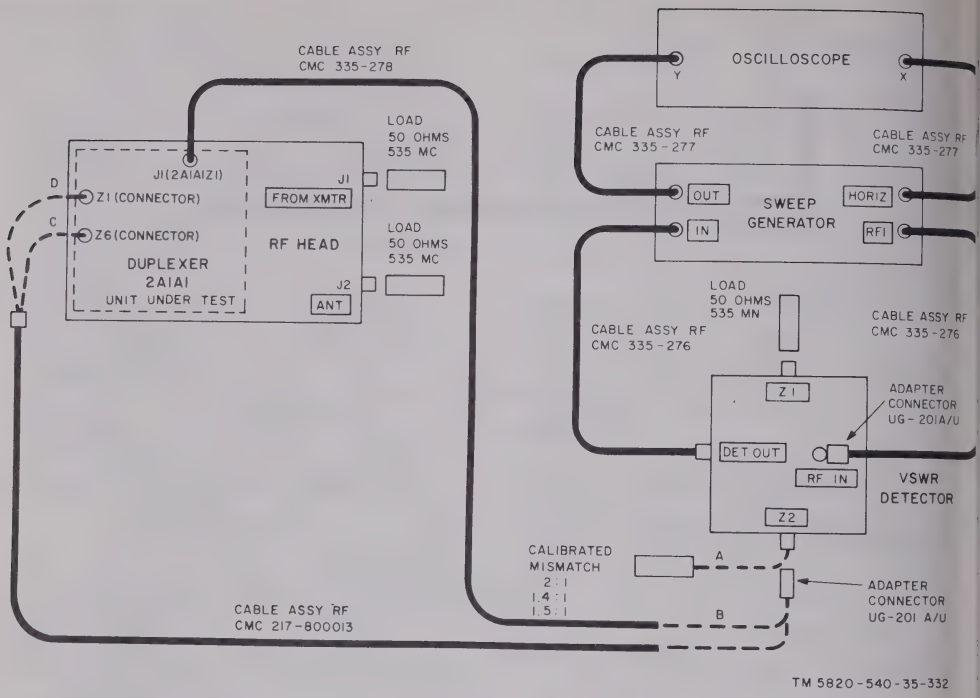


Figure 4-136. Duplexer 2A1A1, vswr check and tape alignment test set-up.

2.0 over the frequency range, and the bandwidth between 2 and 7 MHz.

(*b*) *Receiver filter.*

1. Reset the sweep generator to 405 MHz, set the XMTR DUPL control fully counterclockwise and set the RCVR SIG control to channel 410.

2. With the aid of the markers, check to see that the receiver filter is tuned to 405 MHz. The vswr displayed on the oscilloscope should be less than 2.0 and the bandwidth between 2 and 7 MHz.

3. Tune the sweep generator through to 220 MHz and simultaneously tune the RCVR SIG control through to channel 40. The vswr displayed on the oscilloscope should be less than 2.0 over the frequency range, and the bandwidth between 2 and 7 MHz.

(6) *RCVR SIG alignment check.*

(*a*) Reset the RCVR SIG control to channel 410 and turn the XMTR DUPL control fully counterclockwise.

(*b*) Reset the sweep generator to 405 MHz.

(*c*) With the aid of the markers adjust the RCVR SIG control until the maximum amplitude of the response is tuned to precisely 40 MHz.

(*d*) Check to see that channel numbe is not more than 1/8-inch above or below the calibration mark center line of the RCVR CHANNEL window.

(*e*) Check the alignment of the tape very 20 channels down to channel 40. Check to see that the indicated channel and the frequency are in the following relationship:

$$\text{Channel number} = 2(\text{Frequency (MHz)} - 20)$$
$$\text{Frequency (MHz)} = \frac{\text{Channel number}}{2} + 20$$

(*f*) If the tape requires adjustment, refer to paragraph 4-103 *b*.

(7) *XMTR DUPL alignment check.*

(*a*) Set the XMTR DUPL control to channel 410 and the RCVR SIG control fully counterclockwise.

(*b*) Reset the sweep generator to 405 MHz.

(c) With the aid of the markers adjust TR DUPL control until the maximum am- of the response is tuned to precisely z.

(d) Check to see that the channel number not more than 1/8-inch above or below the calibration mark (center line) of the XMTR CHANNEL window.

(e) Check the alignment of the tape every 20 channels as described in (6)(e) above.

(f) If the tape requires adjustment, refer to paragraph 4–103c.

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oubleshooting (fig. 6–18).

Symptom	Probable cause	Checks and corrective measures
insertion loss in receiver th (*b*(1)).	*a.* Defective low pass filter 2A1A1FL1. (fig. 3-18)	*a.* Modify test setup fig. 4-135A. Disconnect cables connected to 2A1A1AJ2 and P2 (2A1AR1J1). Connect cable from 6db attenuator to J2 (2A1A1A1). Repeat *b*(1)(*b*) through (*e*) above. Disconnect cables from 3 db attenuator and J2 (2A1A1A1). Connect the cable from the 6 db attenuator to the 3 db attenuator. Repeat para *b*(1) (*g*). The insertion loss at this point should not be more than 1.5 db. If the indication above is normal, replace low pass filter 2A1A1FL1 (para 3-62).
	b. Defective impedance matching network 2A1A1Z1.	*b.* If indication above is abnormal disconnect 2A1A1Z1 from duplexer cavity 2A1A1A1Z4 (fig. 3-16). Refer to figure 4-135; connect the 3-db attenuator to the Z4 duplexer cavity using rf cable assembly CMC 217-800013. Repeat para *b*(1) (*b*) through (*e*). Disconnect cables from 3-db attenuator and J2 (2A1A1A1). Connect the cable from the 6-db attenuator to the 3-db attenuator and repeat para *b*(1)(*g*). If the insertion loss is not more than 1.5 db, replace 2A1A1Z1 (para 4-98).
	c. Defective bandpass filter 2A1A1A1.	*c.* If result in *b* above is abnormal, return rf head to higher category maintenance for replacement of 2A1A1A1.
normal indication, linearity est (para *b* (2)).	Defective bandpass filter 2A1A1A1.	Return rf head to higher category maintenance for replacement of 2A1A1A1.
gh insertion loss in transmit ath (para *b* (3)).	*a.* Defective impedance matching network 2A1A1Z1.	*a.* Disconnect 2A1A1Z1 from duplexer cavity 2A1A1A1Z6 (fig. 3-16); refer to paragraph 4-98 for removal of connector 2A1A1Z1. Modify test set-up figure 4-135B by connecting 3-db attenuator to the Z6 duplexer cavity using rf cable assembly CMC 217-800013. Repeat para *b*(3)(*b*) through (*e*). Disconnect cables from 3-db attenuator and adapter connected to FROM XMTR connector. Connect the cable from the 6 db attenuator to the 3 db attenuator and repeat para *b*(3)

Symptom	Probable cause	Checks and corrective measures
		(*g*). If insertion loss is not more than 1.5 db replace 2A1A1Z1 (para 4-98).
	b. Defective bandpass filter 2A1A1A1.	*b*. If result in *a* above is abnormal return rf head to higher category maintenance for replacement of 2A1A1A1.
4. Abnormal indication, linearity test (para *b*(4)).	Defective bandpass filter 2A1A1A1.	Return rf head to higher category maintenance for replacement of 2A1A1A1.
5. High vswr transmitter filter (para *b*(5) (*a*)).	*a*. Defective bandpass filter 2A1A1A1.	*a*. Disconnect 2A1A1Z1 duplexer cavity Z6 (fig. 3-16); refer to paragraph 4-98 for removal of 2A1A1Z1 connector. Conn equipment as shown in figure 4-136C. Repeat para *b*(5) (*a*) above, vswr displayed should be less than 1.4 : 1. If indication abnormal, return rf head to higher category maintenance for replacement of 2A1A1A1.
	b. Defective impedance matching network 2A1A1Z1.	*b*. If indication in *a* above is normal replace 2A1A1Z1 (para 4-98).
6. High vswr receiver filter (para *b* (5) (*b*)).	*a*. Defective bandpass filter 2A1A1A1.	*a*. Disconnect 2A1A1Z1 from duplexer cavity 2A1A1A1Z4 (fig 3-16); refer to paragraph 4-98 for removal of 2A1A1Z1 connector. Connect equipmen as shown in figure 4-136D. Repeat subpara *b*(5)(*b*) *1*. and *2*. above; vswr displayed should be less than 1.5 : 1. If indication abnormal, return rf head to high category maintenance for replacement of 2A1A1A1.
	b. Defective impedance matching network 2A1A1Z1.	*b*. If indication in *a* above normal replace 2A1A1Z1 (para 4-98).
7. Unable to realign channel indication tapes.	Defective bandpass filter 2A1A1A1.	Return rf head to higher category maintenance for replacement of 2A1A1A1.

4–58. Impedance Matching Network 2A1A1Z1

a. Test Equipment and Material Required.

Equipment	Common Name
Generator, Sweep Signal AN/USM-203	Sweep generator
Oscilloscope AN/USM-281	Oscilloscope
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit

b. Initial disassembly. In order to test 2A1A1Z1, remove control panel 2A1MP2 as described in paragraph 4–99. Disconnect the T-junction as described in paragraph 4–98*b* and *c*.

c. Test Procedure.

(1) *Equipment calibration.*

(*a*) Connect equipment as shown in figure 4–137A.

(*b*) Set the sweep generator to sweep, adjust the oscilloscope controls for a co ient display of the vswr curve; for example, it the baseline of the display on the bottom li the graticule and the vswr curve displaced the baseline by two-thirds the height of graticule. Record the resultant vswr curve tween 220 MHz and 405 MHz. This repre vswr of 1.4.

(2) *Operational check.*

(*a*) Connect the equipment as show figure 4–137B.

(*b*) Sweep the sweep generator bet 220 MHz and 405 MHz. The resultant curve played on the oscilloscope should not exceed recorded in (1) (*b*) above.

(*c*) If the vswr curve observed in (2 above is not as specified, continue with (3) low for alignment procedures.

(3) *Alignment procedure.*

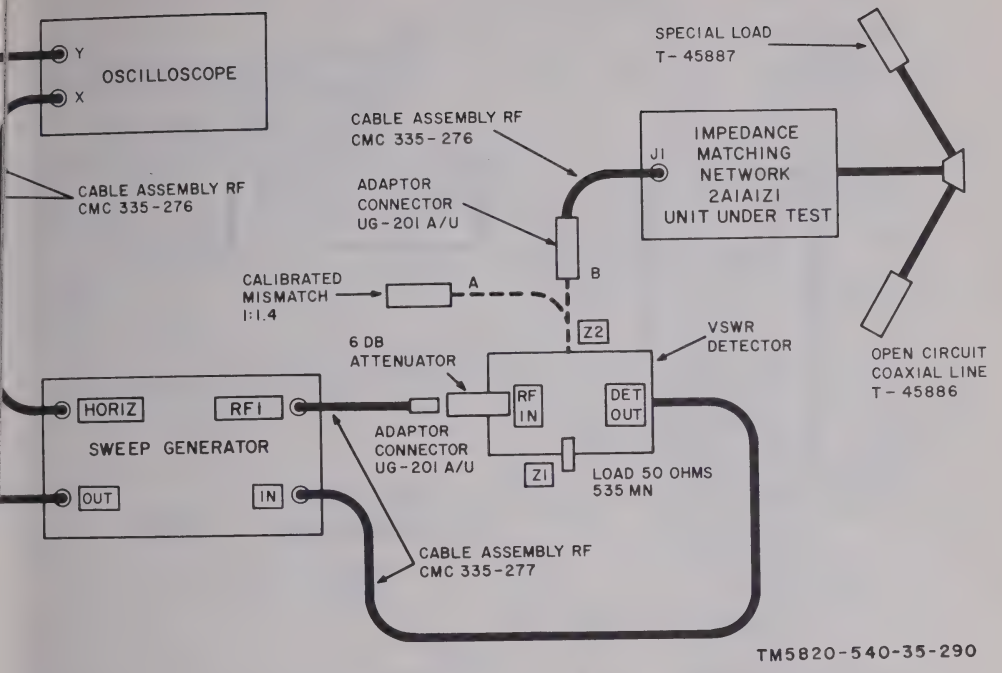


Figure 4-137. Impedance matching network 2A1A1Z1 operational check test set-up.

(*a*) On unit under test, adjust trimmer ors C1 and C2 alternately until the deflec- the vswr trace displayed on the oscillo- does not exceed that recorded in (1) (*b*)

(*b*) On the unit under test, interchange ecial matched load and the open circuit co- ne.

(*c*) Sweep the sweep generator between Hz and 405 MHz. If necessary, readjust mmer capacitors on the unit under test until vr curve displayed on the oscilloscope meets quirements specified in (2)(*b*) above.

(*d*) The 1.4 vswr limit must be met with ecial matched load and the open circuit co- line in either position.

roubleshooting.

1) If a vswr of 1.4 cannot be achieved by ing trimmer capacitors C1 and C2, remove nit as described in paragraph 4-98. Check nections and connectors for high-resistance and looseness.

2) If the connections and connectors are in condition, replace C1 or C2, and repeat sub- raph *c* above.

(3) Reinstall the repaired or replacement unit as described in paragraph 4-98.

(4) Perform the operational checks for the duplexer assembly as described in paragraph 4-57.

4-59. Electronic Frequency Converter 2A1A2

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Receiver TS-2867(V)1/ GRM-95(V)	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit
Generator Signal AN/USM-44A	Signal generator
Voltmeter, Electronic ME-30A/U	VTVM
Wattmeter AN/URM-98	Power meter

b. Test Procedure.

(1) Connect the equipment as shown in figure 4-138A.

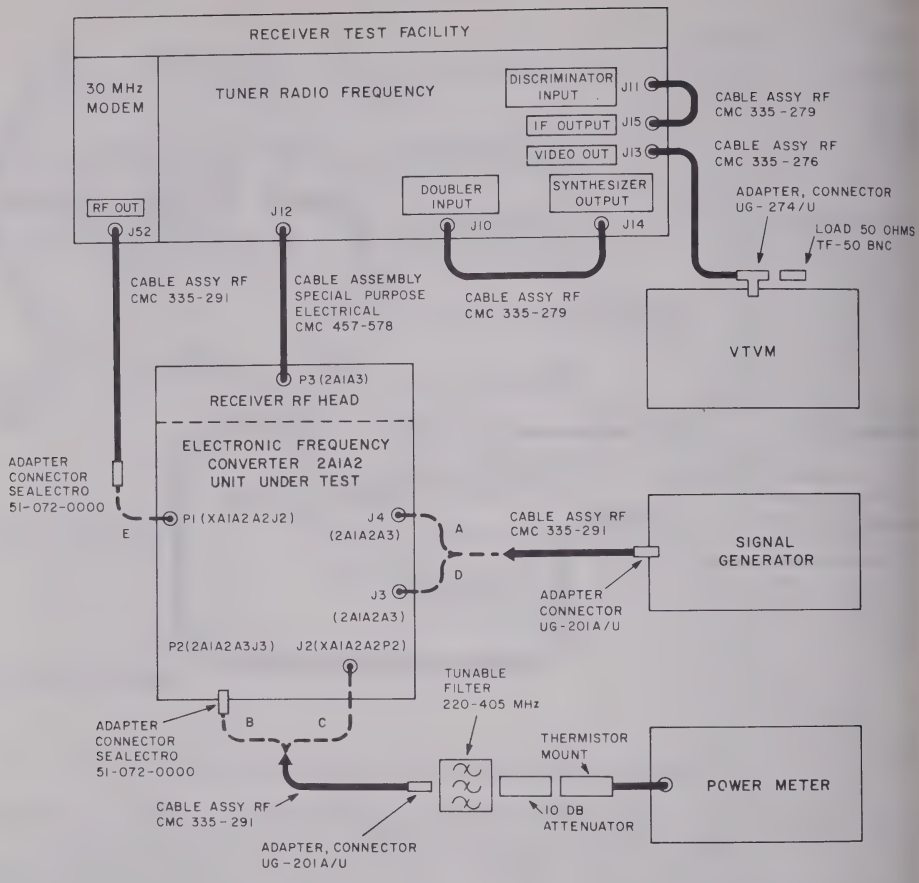


Figure 4-138. Electronic frequency converter 2A1A2 operational check, test set-up.

(2) Set the unit under test RCVR CHANNEL and RCVR SIG controls to channel 200 and the XMTR DUPL control to channel 40.

(3) Tune the signal generator to 300.0 MHz at a level of –50 dbm.

(4) Set the test facility switches as follows:

Switch	Switch position	Normal indication
S1	ON	
S5	S6	
S7	AGC	
S6	OSC	M1 should indicate between 20% and 90% of full scale
S6	DBLR	M1 should indicate betw 20% and 90% of full
S6	MULTIPLIER	M1 should indicate betw 20% and 90% of full (Adjust MULT PEAK unit under test for m imum indication)
S6	REC SIG	M1 should indicate betw 20% and 90% of full

(5) The VTVM connected to test facility VIDEO OUT should indicate less than – dbm. This corresponds to a noise factor db.

bleshooting (fig. 6–18)

Symptom	Probable cause	Checks and corrective measures
IULTIPLIER and REC r M1 readings.	*a.* Defective frequency multiplier 2A1A2A1.	*a.* Disconnect P2 (2A1A2A3J3) plug (fig. 3-18) from connector J3 of bandpass filter assy 2A1A2A3 and connect power meter to P2 (2A1A2A3J3) (fig. 4-138B). Tune selective filter to 330 MHz and MULT PEAK for maximum indication on the power meter. Power meter should indicate +7 dbm ±2 db. If output abnormal remove frequency multiplier 2A1A2A1 (para 4-99) and test as shown in paragraph 4-60.
	b. Defective bandpass filter assembly 2A1A2A3.	*b.* If power at P2 (2A1A2A3J3) normal, reconnect P2 to J3 of 2A1A2A3, remove frequency mixer stage 2A1A2A2 (para 3-60) and connect power meter to J2 (X2A1A2A2P3) (fig. 4-138C). Power meter should indicate no less than 3 db below level obtained in *a* above. (1) If indication abnormal, connect signal generator tuned to 330.0 MHz at an output level of +7 dbm to J3 of 2A1A2A3 (fig. 4-138). Adjust MULT PEAK for maximum indication on power meter. Power meter should indicate no less than +4 dbm. If required output not obtained, refer to higher echelon for replacement of 2A1A2A3. (2) If required output obtained in *b*(1) above, loosen the Allen screw on the flexible shaft connected to 2A1A2A1 and carry out alignment procedures (para 4-100 *b.*).
	c. Defective frequency mixer stage 2A1A2A2.	*c.* If indication in *b* abnormal, replace 2A1A2A2 (para 3-61), and test as described in para 4-61.

equency Multiplier 2A1A2A1

Equipment and Material Required.

Equipment	Common Name
acility, Receiver 2867(V)1/ M-95(V)	Receiver test facility
ory Kit, Facilities Set -1173(V)1/ M-95(V)	Accessory kit
eter AN/URM-98	Power meter
scope AN/USM-281	Oscilloscope
ator, Sweep Signal /USM-203	Sweep generator

b. Test Procedure.

NOTE

Remove the unit as described in paragraph 4–100.

(1) *Bandwidth and tuning check.*

(*a*) Connect the test equipment as shown in figure 4–139A.

(*b*) Set the sweep generator output level to +9 dbm over the frequency range of 48 MHz to 73 MHz and set the rf function switch to SWEEP.

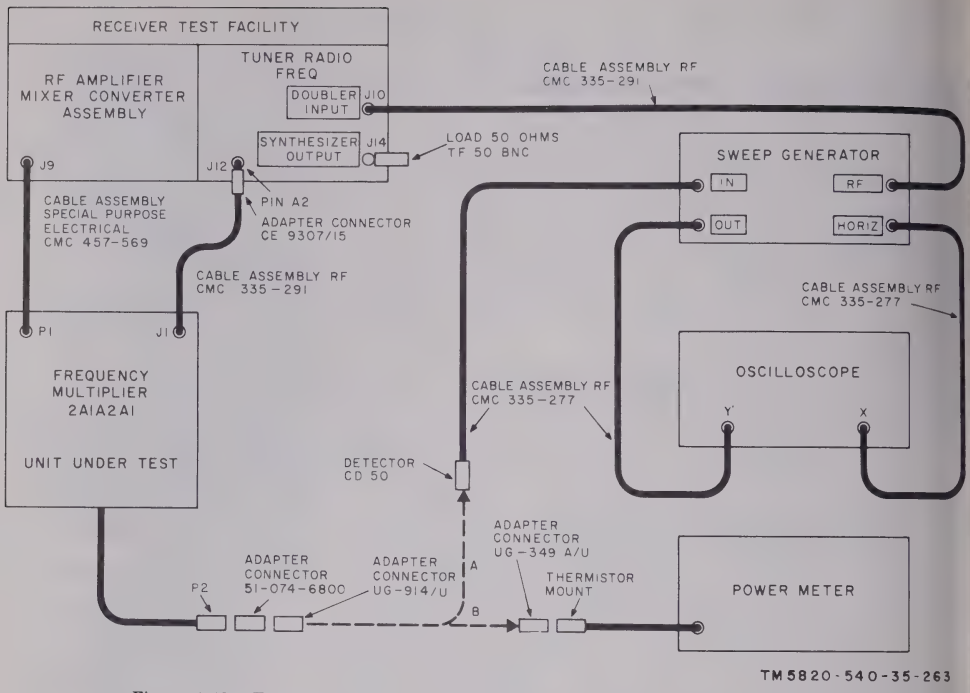


Figure 4-139. Frequency multiplier 2A1A2A1, gain, bandwidth, and tuning checks test set-up.

(*c*) Set the SWEEP dial to 72.5 MHz, and the SWEEP WIDTH control 1/4-turn from minimum.

(*d*) On the unit under test, adjust the control cam until the H datum mark is in line with the cam-follower stud (fig. 4–140).

(*e*) Set the test facility switches as follows:

Switch	Position
S1	ON
S4	ON
S6	REFL PWR
S8	47.5

(*f*) The waveform observed on the oscilloscope should be similar to that shown in figure 4–141A.

(*g*) Set the SWEEP dial of the sweep generator to 62.5 MHz.

(*h*) On the unit under test, set the cam to the L datum line. The oscilloscope display should be similar to that shown in figure 4–141B.

(*i*) On the unit under test, set and hold the cam at the M datum line. Set the sweep generator SWEEP dial to 48.3 MHz and 72.5 MHz in turn; observe the response displayed on the oscilloscope.

(2) *Gain check.*

(*a*) Set the sweep generator rf function switch to CN and check to see that the sweep generator output is at least +12 dbm over the frequency range of 250 to 435 MHz.

(*b*) Connect P2 of the unit under test to the power meter as shown in figure 4–139.

(*c*) On the unit under test, set the control cam to the L datum line.

(*d*) Set the sweep generator SWEEP dial to 48.3 MHz.

(*e*) Slowly rotate the SWEEP dial to 72.5 MHz while at the same time manually tracking the unit. Power output should be +7 dbm 0.5 db across the times-3 band. Observe that the beam is at the H datum line.

(3) *Vswr check.*

(*a*) Set the sweep generator rf function switch to CW and adjust the output to +5 dbm over the frequency range of 250 to 435 MHz.

(*b*) Connect the test equipment as shown in figure 4–142A with the calibrated mismatch connected to port Z2 of the vswr detector. Calibrate the oscilloscope.

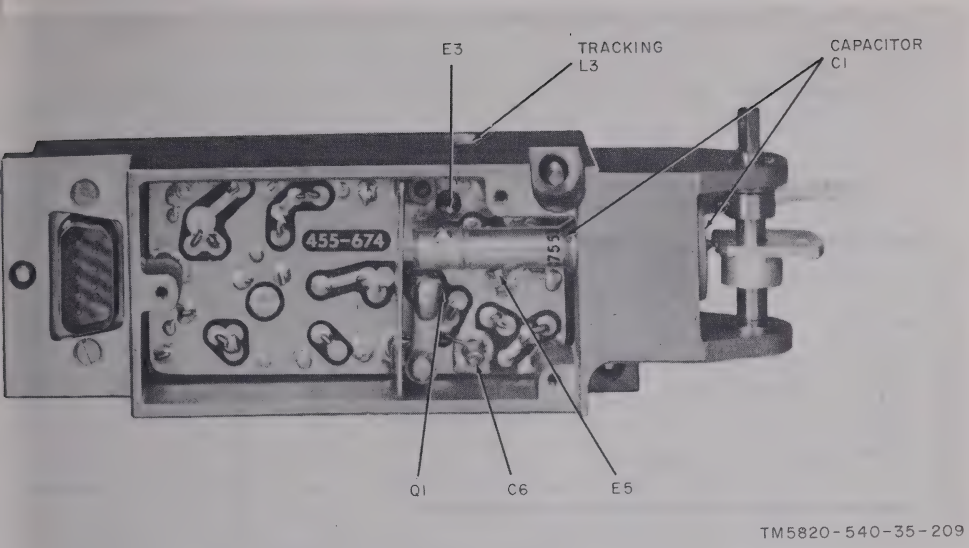


Figure 4-140. Frequency multiplier 2A1A2A1, cover removed.

(*c*) Remove the calibrated mismatch and ct the unit under test to the vswr detector own in figure 4–142B. The vswr indicated cilloscope should be less than 1.5.

(*d*) Check to see that the vswr remains n the specified limit by turning the cam the L datum line to the H datum line and taneously tuning the sweep generator from Hz through to 435 MHz.

roubleshooting (fig. 2–45).

Symptom	Checks and corrective measures
put indication	*a.* Check components in the signal path for open circuit. Replace components as required. *b.* Check +12v dc at C6 (fig. 4-143) and E3 (fig. 4-140). Replace FL1 or L3 if necessary. *c.* Check C4 for short-circuit; replace if necessary.
high output	Check and replace Q1 transistor (fig. 4-40)
nal high and/or low uency response.	*a.* Carry out realignment procedure as described in *d* below. If adjustment cannot improve response, replace L3 and repeat realignment procedures.
Symptom	Checks and corrective measures
	b. If frequency response is still abnormal with replacement of L3, replace C1 and repeat the realignment procedure. Refer to *e* below for C1 replacement procedure.
Spurious outputs on the response curve.	*a.* Check the wire from E6 to FL1 (fig. 4-143). If any of the strands in this wire are broken spurious outputs on the response curve will result. *b.* Check and replace transistor Q1.
High vswr at high and/or low frequencies.	Check resistors R5, R6, and R7 for open or shortcircuit; replace component as required.

d. Realignment Procedure. After repairing a module repeat all tests above and carry out the following adjustments for optimum performance:

(1) Connect the equipment as shown in figure 4–139A.

(2) Set the sweep generator output level to +9 dbm over the frequency range of 48 MHz to 3 MHz and the rf function switch to SWEEP.

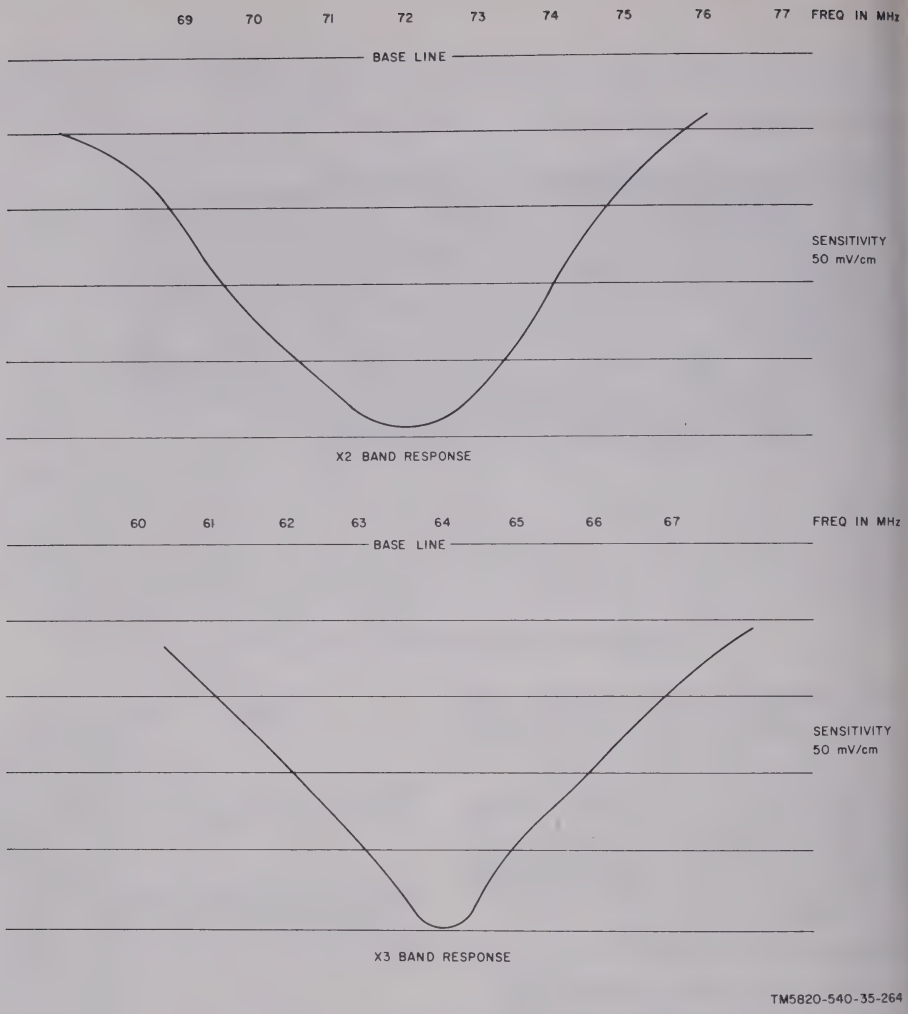


Figure 4-141. Frequency multiplier 2A1A2A1 response waveforms.

(3) Set the SWEEP dial to 72.5 MHz, and the SWEEP WIDTH control one-quarter turn from minimum.

(4) On the unit under test, adjust the control cam until the H datum mark is in line with the cam-follower stud (fig. 4-140).

(5) If C4 has been replaced, turn fully clockwise; no other adjustment is required for C4.

(6) Set the test facility switches as follows:

Switch	Position
S	ON
S4	ON
S6	REFL PWR
S8	47.5

(7) Adjust the slug of coil L3 until it is halfway into the coil former.

(8) The oscilloscope display should be s shown in figure 4-141A, with the response c fined to area of 71 MHz to 73 MHz. If necessa adjust R4 to increase the gain and slightly re just L3 slug towards the outside end of the c former to improve the response.

(9) If C1 has been replaced and the sponse is not confined to the area of 71 MI slightly adjust C1 and repeat (8) above.

(10) On the sweep generator set the SWEE dial to 62.5 MHz.

(11) On the unit under test, set cam to datum line. The oscilloscope display should

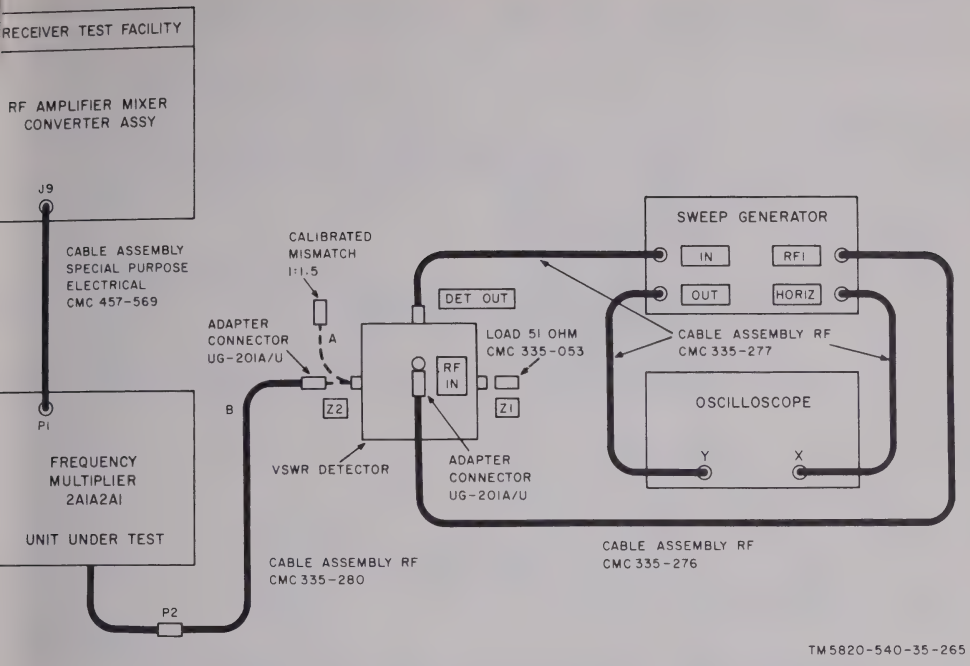


Figure 4-142. Frequency multiplier 2A1A2A1 vswr check test set-up.

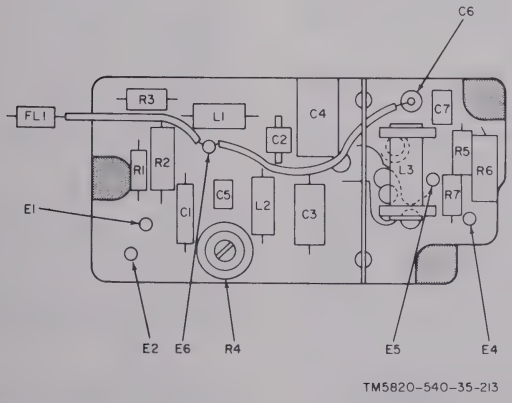


Figure 4-143. Frequency multiplier subassembly 2A1A2A1A1 parts location.

ar to that shown in figure 4-141B. If the nse is not confined to 63 MHz ± 1MHz ust L3.

2) Repeat (1) through (11) above until esired conditions are achieved. Adjust R4 to ce the response amplitude between the and low frequencies.

(13) On the unit under test, set and hold the cam at the M datum line. Set the sweep generator SWEEP dial to 48.3 MHz and 72.5 MHz in turn; observe the response displayed on the oscilloscope.

e. Replacement of C1 (fig. 4-144).

(1) Locate and remove the dowel pin securing the control cam to the shaft.

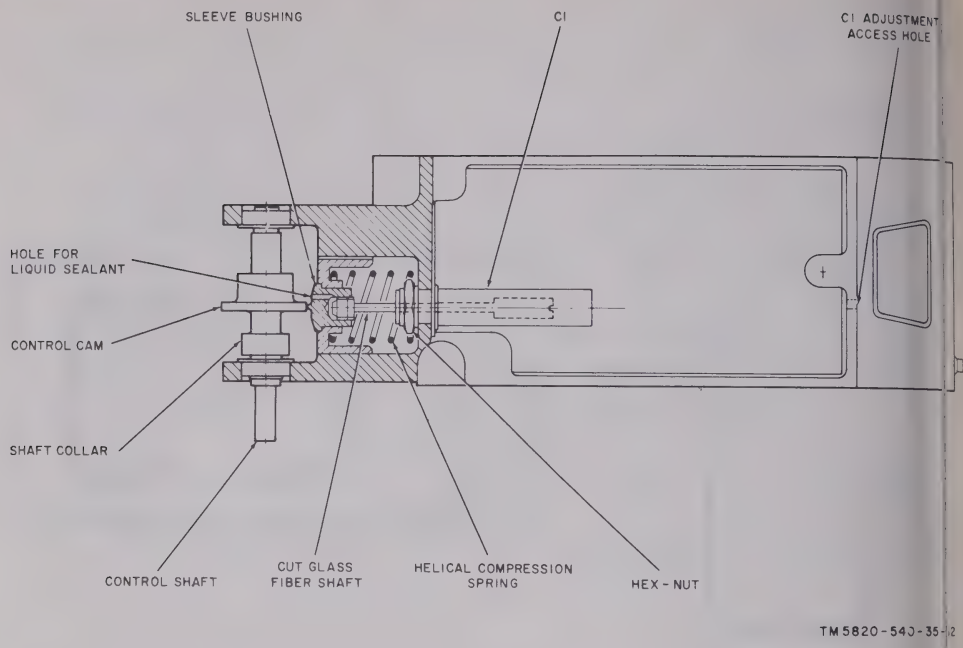


Figure 4-144. Frequency multiplier 2A1A2A1 cross-section view, showing capacitor C1.

(2) Melt the sealant on the set screws which secure the shaft collar, by applying a heated soldering iron to the set screws.

(3) Loosen the set screws and remove the shaft and control cam.

(4) Insert a screwdriver through the access hole in the housing above P1 and unscrew the slug inside C1 until the glass-fiber shaft breaks. The sleeve bushing will be forced out by the helical compression spring when the shaft breaks.

(5) Unsolder the wires attached to the body of the capacitor.

CAUTION

Do not damage the wires connected between C1 and the circuit board, their length and gauge are critical.

(6) Remove the hexagonal nut securing the capacitor to the housing.

(7) Locate and remove the three screws securing the printed circuit board to the chassis.

(8) Lift the printed circuit board sufficiently to permit C1 to be removed.

(9) Remove C1 by sliding it under the shield attached to the printed circuit board.

(10) Install the replacement capaci sliding the component under the shield i mounting hole.

(11) Secure the replacement capacito the hexagonal nut.

(12) Replace the helical compression and install a new sleeve bushing.

(13) Press the bushing into place and same time, using a thin screwdriver, scr capacitor slug into the bushing until sn

CAUTION

Do not exert undue torque on the capa itor slug.

(14) Unscrew the capacitor slug on one-half turns.

(15) Secure the printed circuit board w three mounting screws.

(16) Solder the two wires from the p circuit board to the capacitor.

(17) Replace the control cam, shaft and shaft. Tighten the set screws.

(18) Coat the set screws on the shaft with liquid sealant.

(1) Reconnect the module to the test facility and repeat the alignment procedure in *b* above.

(2) After the alignment of module, seal the trimmer of C1 by placing a small amount of liquid lacquer into the hole at the top of sleeve bushing.

(2) Replace the module as described in paragraph 4–100.

61 Frequency Mixer Stage 2A1A2A2

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility Receiver TS-2867(V)1/GRM-95(V)	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V)	Accessory kit
Generator, Signal AN/USM-44A	Signal generator
Generator, Sweep Signal AN/USM-203	Sweep generator
Oscilloscope AN/USM-281	Oscilloscope
Wattmeter AN/URM-98	Power meter
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) *Calibration of test set-up.*

(*a*) Connect test equipment as shown in figure 4–145A.

(*b*) Set the test facility switches as follows:

Switch	Position
S1	ON
S9	30 MHz
S14	30 MHz
S4	ON
AT1	50 DB

(*c*) Adjust the GAIN control on the test facility RF AMPLIFIER-MIXER CONVERTER section for an indication of –10 dbm on the power meter.

(*d*) Connect the test equipment as shown in figure 4–145B, with the variable attenuator set to 0 db.

(*e*) Record the position of the baseline display on the oscilloscope graticule. This represents the –10 dbm calibration mark.

(*f*) Set the variable attenuator to 1 db and record the new position of the baseline display on the oscilloscope graticule. This represents the –1 dbm calibration mark.

(*g*) Set the variable attenuator to 2 db and record the new position of the baseline display on the oscilloscope graticule. This represents the –12 dbm calibration mark.

(*h*) Set up the equipment as shown in figure 4–146A.

(*i*) Observe the oscilloscope display and adjust the sweep generator controls for a flat response of maximum sweep width centered on 350 MHz. Set the sweep generator to CW and adjust the output level for 0 dbm as indicated on the power meter. Set the sweep generator to SWEEP.

(*j*) Set the signal generator to 350 MHz at an output level of +5 dbm as indicated on the power meter (fig. 4–146B).

(*k*) Connect the signal generator output to EXT MARKER IN on the sweep generator (fig. 4–146C).

(*l*) Vary the signal generator frequency until a low beat-frequency with the 350 MHz marker is observed on the oscilloscope.

(*m*) Increase the output attenuator on the sweep generator to obtain an output level of –50 dbm.

(*n*) Set the sweep generator frequency to 320 MHz with a sweep width of ± 1 MHz.

(*o*) Set test facility switch S4 to OFF.

(2) *Gain, frequency response, and metering checks.*

(*a*) Set up the test equipment as shown in figure 4–147.

(*b*) Set test facility switch S5 to S4.

(*c*) Set test facility switch S4 to ON. The oscilloscope display should be greater than the –12 dbm calibration mark recorded on the oscilloscope graticule in (1) (*g*) above.

(*d*) Flatness of the response from 319 MHz to 321 MHz should be less than 1 db. Use the 1 MHz markers for reference.

(*e*) Keeping the output level constant at +5 dbm, change the frequency of the signal generator by 10-MHz stops over the frequency range of 250 MHz to 435 MHz. Test facility meter M1 should indicate between 20 percent and 60 percent of full scale deflection.

(3) *Input vswr checks.*

(*a*) Connect the test equipment as shown in figure 4–148A.

(*b*) Adjust the output level and sweep width controls of the sweep generator for a flat response over the frequency range of 220 MHz to 405 MHz as viewed on the oscilloscope.

(*c*) Connect the power meter to the rf output of the sweep generator (fig. 4–148B).

(*d*) Set the sweep generator to CW and adjust its rf attenuator for –10 dbm as indicated on the power meter.

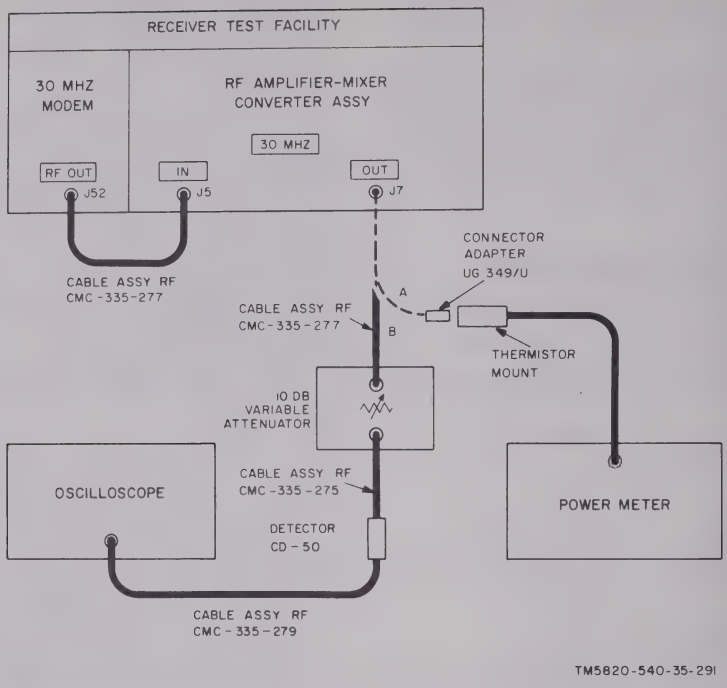


Figure 4-145. 30 MHz gain calibration, test set-up.

(*e*) Reconnect the rf output of the sweep generator to the vswr detector (fig. 4–148A).

(*f*) Adjust the oscilloscope controls for a convenient display of the vswr curve. *For example,* position the baseline of the display on the bottom line of the graticule and the vswr curve near the top of the graticule. Record the resultant vswr curve between 200 MHz and 405 MHz.

(*g*) Replace the 1.75:1 calibrated mismatch with the unit under test (fig. 4–148C). The resultant vswr curve displayed on the oscilloscope, at any frequency between 220 MHz and 405 MHz, should not exceed that recorded in (*f*) above.

(*h*) Disconnect the unit under test from the vswr detector and in its place connect the 2:1 calibrated mismatch (fig. 4–148D).

(*i*) Set the sweep generator to SWEEP and adjust its output level to +7 dbm as indicated on the power meter (fig. 4–148B).

(*j*) Disconnect the sweep generator from the power meter and connect the sweep generator to the vswr detector (fig. 4–148A).

(*k*) Repeat (*f*) above, over the frequency range of 250 MHz to 435 MHz.

(*l*) Replace the 2:1 calibrated m[illegible]natch with the 1.75:7 calibrated mismatch (fig. 4[illegible]8A). Record the resultant vswr curve displayed [illegible]n th oscilloscope over the frequency range of 2[illegible] MHz to 435 MHz.

(*m*) Replace the 1.75:1 calibrate[illegible] mismatch with the unit under test (fig. 4[illegible]48E). The resultant vswr curve displayed on th[illegible] oscilloscope at any frequency between 250 M[illegible]z an[illegible] 415 MHz should not exceed that recor[illegible]ed [illegible] (*m*) above, and at any frequency betwe[illegible]n 41[illegible] MHz and 435 MHz, the vswr curve sho[illegible]d no[illegible] exceed that recorded in (*k*) above.

c. Troubleshooting (fig. 2–46).

Symptom	Checks and [illegible]rrecti[illegible] measu[illegible]
Poor vswr at P3.	Check resistance of [illegible]1 and components of Q[illegible]emitte circuit.
Poor vswr at P2.	Check resistance of [illegible]1 and components of Q base circuit.
Poor vswr at P2 and P3.	Check resistance of [illegible]1 and components of Q col-lector circuit.
Poor gain or no output.	*a.* Check all compon[illegible]nts in rf path.

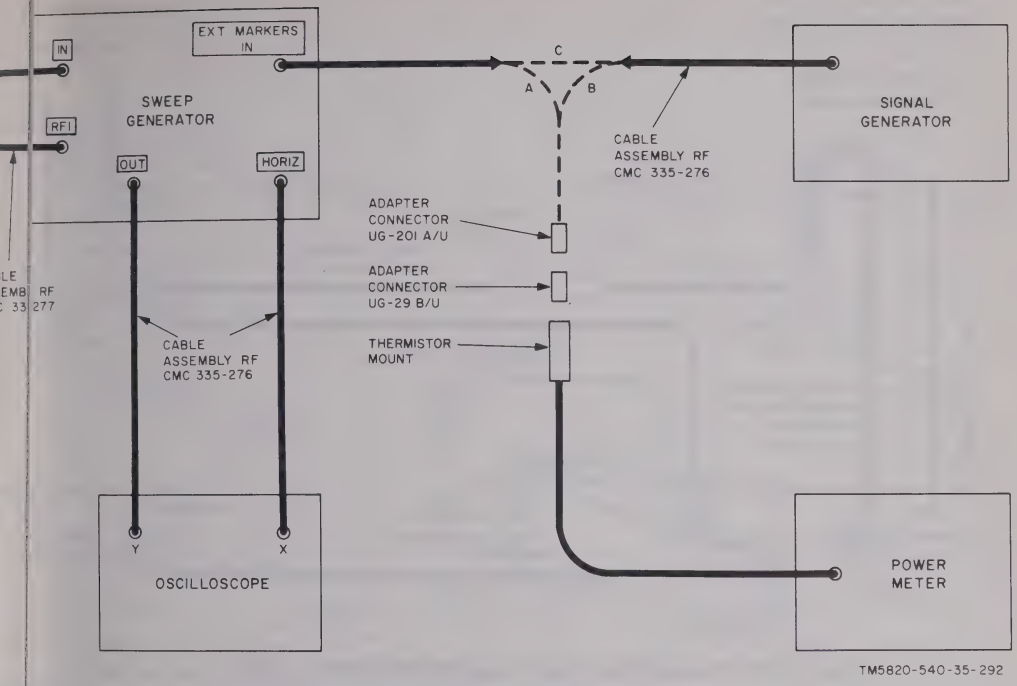


Figure 4-146. Frequency response calibration, test set-up.

Symptom	Checks and corrective measures
	b. Check DC supplies to Q1. (Refer to *d* below).
o NULT meter indication.	Check resistance of components in metering circuit.

. *Voltage and Resistance Measurements* (fig. 49 and 4-150).

NOTE

Us the allocated multimeter for voltage and re stance measurements.

() *Dc voltage measurements referenced to un.*

Test points	Typical indication (volts dc)
Q1 mitter	-0.73
Q1 ase	0
Q1 ollector	6.13

() *Resistance measurements.*

Test points	Typical indication (ohms)
Q base (-) to emitter	460k
Q base (-) to collector (+)	1k
Q base (+) to emitter (-)	1.1k
Q base (+) to collector (-)	850

4-62. Intermediate Frequency Amplifier 2A1A2AR1

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Receiver TS-2867(V)1/ GRM-95(V)	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit
Wattmeter AN/URM-98	Power meter
Oscilloscope AN/USM-281	Oscilloscope
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) Connect the test equipment as shown in figure 4-151.

(2) Set the test facility switches as follows:

Switch	Position
S12	AMPL IF
S9	30 MHz
S14	30 MHz
Attenuator AT1	40 DB
S13	MAN
IF GAIN	Fully CW

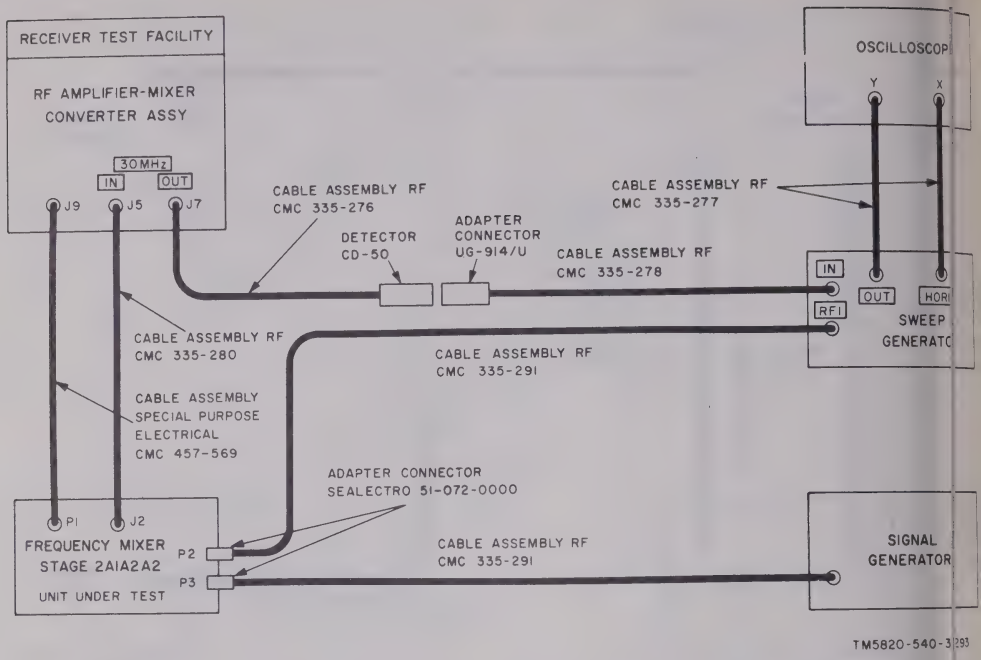


Figure 4-147. Frequency mixer stage 2A1A2A2, gain, frequency response, and metering check, test set-up.

(3) Set test facility switch S1 to ON. The power meter should indicate –10 dbm ±5 db.

(4) Adjust the IF GAIN control for a –10 dbm indication on the power meter.

(5) Set test facility switch S14 to 29 MHz and 31 MHz in turn. The power meter indications at the two positions should not vary by more than **1.2 db from each other.**

NOTE

If the variation of the power meter indi tions should exceed the above specification, ch c the output level from the 30 MHz modem con- nector J52 with attenuator AT1 at 0 db Since the output may vary at 29 MHz and 31 MHz, this variation should be taken into consid ation.

c. Troubleshooting.

Symptom	Checks and corrective measures
Low or no output	*a.* Set the test facility AGC GAIN control to minimum (fully CCW). Check for –11v dc at E2 (2A1A2AR1A6) (fig. 4-152) E6 and E3 (2A1A2AR1AR4) and E3 (2A1A2AR1AR2). Replace the cordwood module through which c is not being passed. *b.* Set test facility attenuator AT1 to 30 DB and the AGC GAIN control to approximately mid range. Check the signal at E4 (2A1A2AR1AR1), it should be 200 mv rms. If abnormal replace 2A1A2AR1AR1. *c.* Disconnect the power meter from connector J34 and set attenuator AT1 to 40 DB. Check the signal at the following points:

Test point	Normal indication
E5 (2A1A2AR1AR2)	650 mv rms
E4 (2A1A2AR1AR3)	1.0v rms
E5 (2A1A2AR1AR4)	7.50 mv rms

Replace the cordwood module with the abnormal indication.

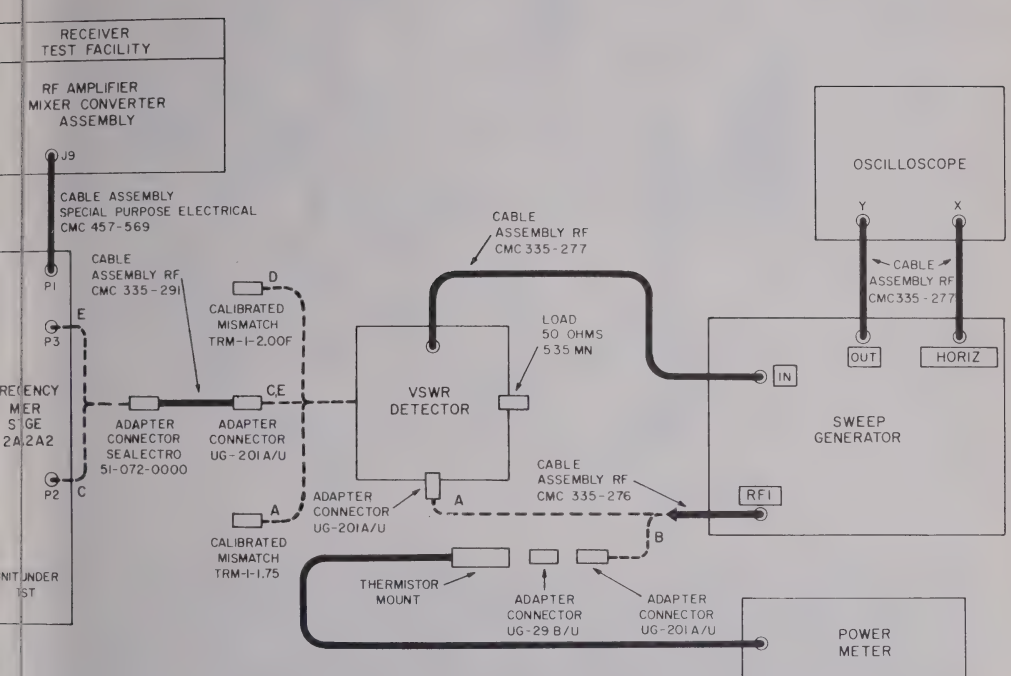


Figure 4-148. Frequency mixer stage 2A1A2A2 input vswr check, test set-up.

6. Connector-Filter Assembly 2A1A3

a. Test Equipment and Material Required.

Equipment	Common Name
Multimeter TS-352B/U	Multimeter

b. Test Procedure. This assembly includes 2A1A3P1, 2A1A3P2, 2A1A3P3, and associated filter connectors. Check each circuit as follows (fig. 6-29):

(1) Check continuity between each pin of 2A1A3P3 and its associated filter connector, and between rf connectors A1 and A2 of 2A1A3P3 and 2A1A3P1 and 2A1A3P2.

(2) Check for short circuits between all pins and between rf connectors of 2A1A3P3 and ground.

c. Repairs.

(1) If the tests above indicate that a filter or connector requires replacement, refer to paragraph 4-99.

(2) If one or more of the small connecting pins of 2A1A3P3 are broken, remove 2A1A3 and

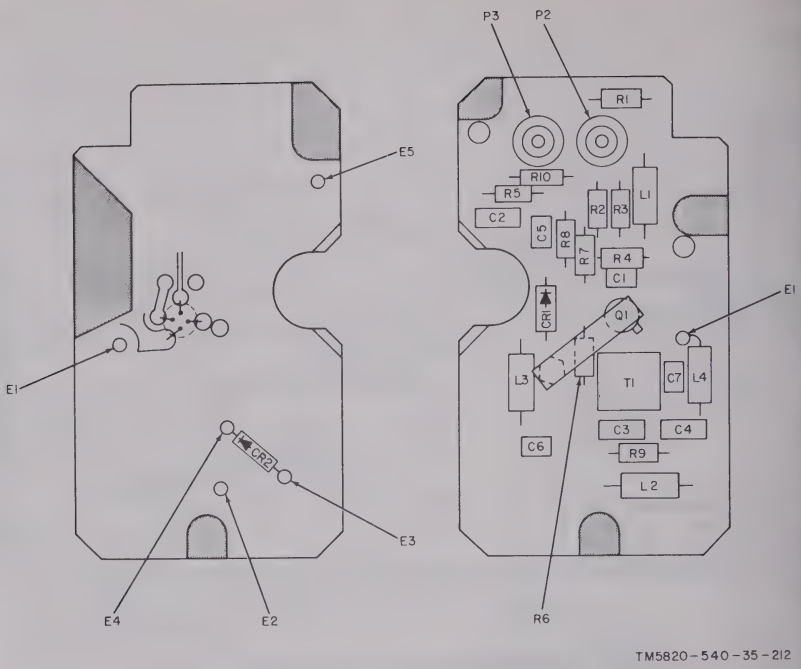


Figure 4-149. Frequency mixer stage 2A1A2A2, parts location.

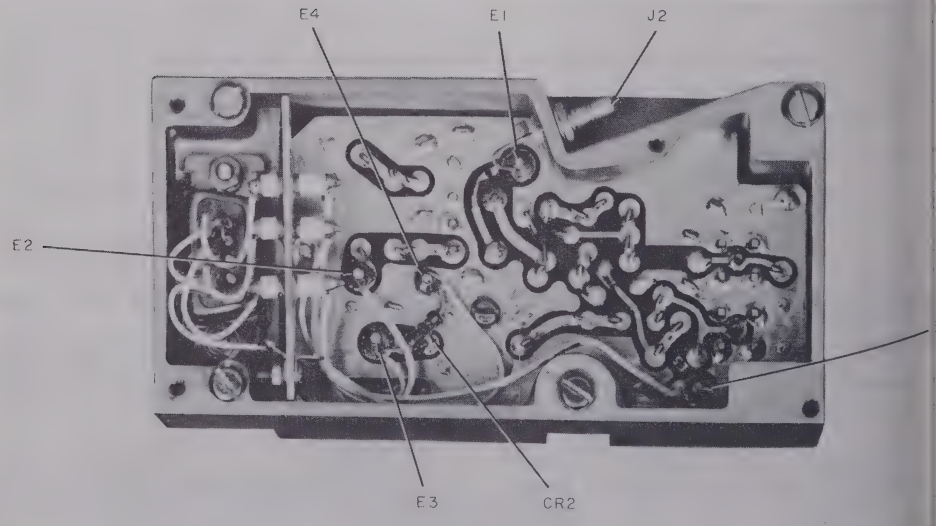


Figure 4-150. Frequency mixer stage 2A1A2A2 cover removed.

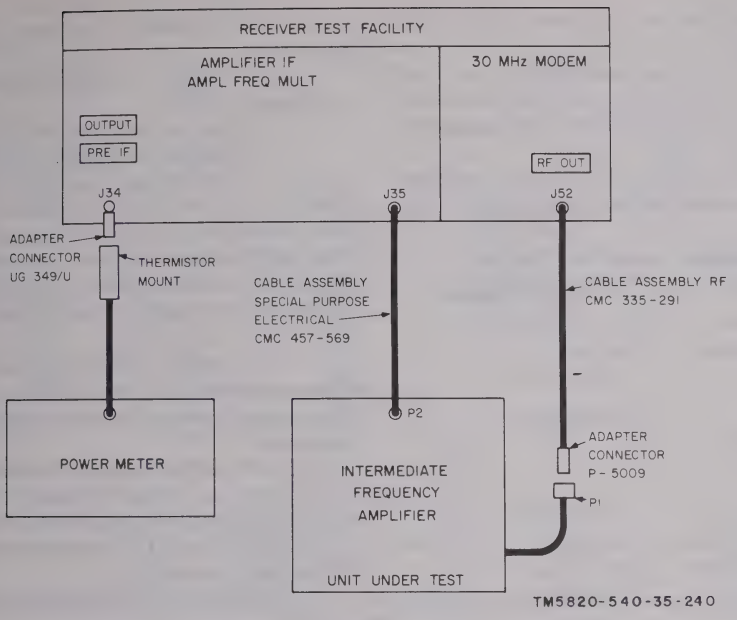


Figure 4-151. Intermediate frequency amplifier 2A1A2AR1 operational check, test set-up.

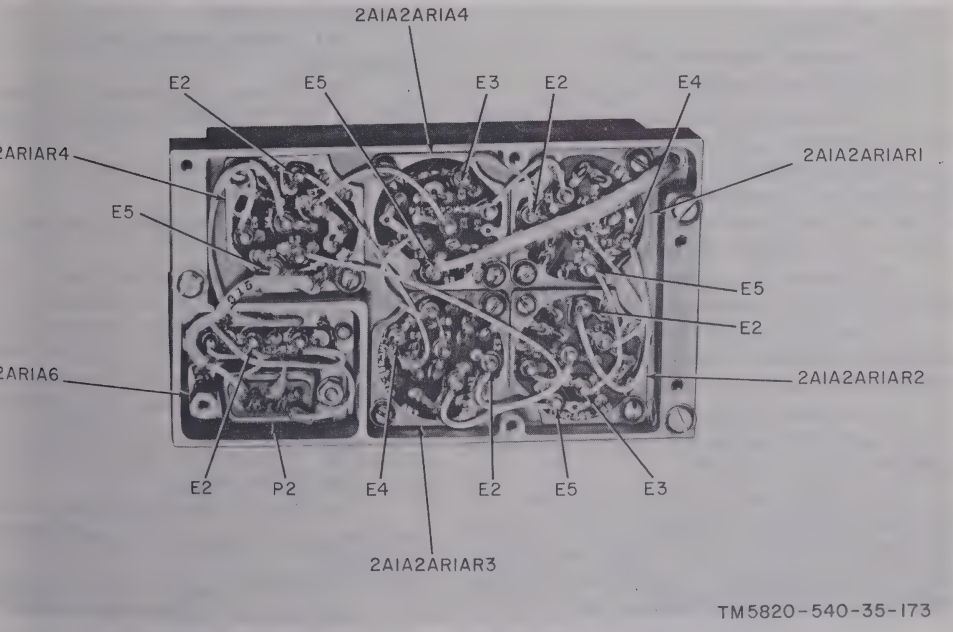


Figure 4-152. Intermediate frequency amplifier 2A1A2AR1, cover removed.

2A1A3P3. Refer to paragraph 4–10 for ment of connectors.

The rf connectors in 2A1A3P3 can be d as follows:

(*a*) Force the rf connectors back onto the connector-filter assembly.

(*b*) Slide the insulating sleeve back along the cable and unsolder the faulty connector.

(*c*) Install the new connector on the rf cable (para 4–10).

(*d*) Push the new connector into the mounting hole in 2A1A3P3 until the retaining springs snap into place, holding the connector firmly.

(*e*) If 2A1A3P1 or 2A1A3P2 requires repairs or replacement, refer to paragraph 4–10.

4–64. Radio Frequecy Amplifier, 2A1AR1

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Receiver TS-2867(V)1/ GRM-95(V)	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit
Generator, Sweep Signal AN/USM-203	Sweep generator
Oscilloscope AN/USM-281	Oscilloscope
Wattmeter AN/URM-98	Power meter
Generator, Thermal Noise SG-419/U	Noise generator
Generator, Signal AN/USM-44A	Signal generator

b. Test Procedure.

(1) *Frequency response test.*

(*a*) *Test set-up calibration.*

1. Connect the test equipment as shown in figure 4–153A.

2. Adjust the output level and sweep width controls of the sweep generator for a flat response over the frequency range of 220 MHz to 405 MHz, as observed on the oscilloscope.

3. Connect the power meter to the rf output of the sweep generator (fig. 4–153B).

4. Set the sweep generator to CW and adjust the rf attenuator for an indication of –15 dbm as indicated on the power meter.

5. Set the sweep generator to sweep and reconnect its rf output to the coaxial switch (fig. 4–153A).

6. Adjust the oscilloscope controls to position the baseline of the display on the bottom line of the graticule and the upper line of the display on the top line of the graticule. This represents the 30-db gain calibration mark.

7. On the sweep generator, increase the rf attenuator by 5 db and note the new trace position. This represents the 25 db calibration mark.

8. On the sweep generator, increase the rf attenuator by 5 db. Initial calibration is now complete.

(*b*) *Frequency response check and adjustment.*

1. Connect the test equipment as shown in figure 4–153A.

2. Set the coaxial switch to position 2.

3. Set facility switches S1 and S4 ON.

4. Sweep the sweep generator from 220 MHz to 405 MHz. The response displayed on the oscilloscope shall be between and 30 db from 220 MHz to 250 MHz, and shall be between the 25 and 30 db calibration marks from 250.1 through 405 MHz.

5. Refer to the troubleshooting procedure in *c* below if the unit under test fails to give some form of overall response on the oscilloscope.

6. Adjust L12, L2, L3, L4, L6, L8 and/or L9 coils as shown in figure 4–154 to obtain the desired response, considering that:

(*a*) L8 and L9 have the greatest effect on the overall bandwidth.

(*b*) L4 has greatest effect on the low end of the band.

(*c*) L2 has greatest effect on the low end portion of the band.

(*d*) L6 has greatest effect on the high end of the band.

(*e*) It may be necessary to place solder links on the "cold" ends of the coils to obtain the desired response.

7. Set switch S4 to OFF.

(2) *Vswr check.*

(*a*) Connect the test equipment as shown in figure 4–155A.

(*b*) Adjust the output level and sweep width controls of the sweep generator for a flat response over the frequency range of 220 MHz to 405 MHz as observed on the oscilloscope.

(*c*) Connect the power meter to the output of the sweep generator (fig. 4–155B).

(*d*) Set the sweep generator to CW and adjust the rf attenuator for a –15 dbm indication on the power meter.

(*e*) Set the sweep generator to sweep and reconnect its rf output to the coaxial switch (fig. 4–155A).

(*f*) Set the coaxial switch to position 2.

(*g*) Set test facility switch S4 to ON.

(*h*) Connect the calibrated mismatch to the bi-directional coupler (fig. 4–155C) and adjust the oscilloscope controls for a convenient display of the vswr curve. For example, the baseline of the display on the bottom line of the graticule, and the vswr curve displaced from

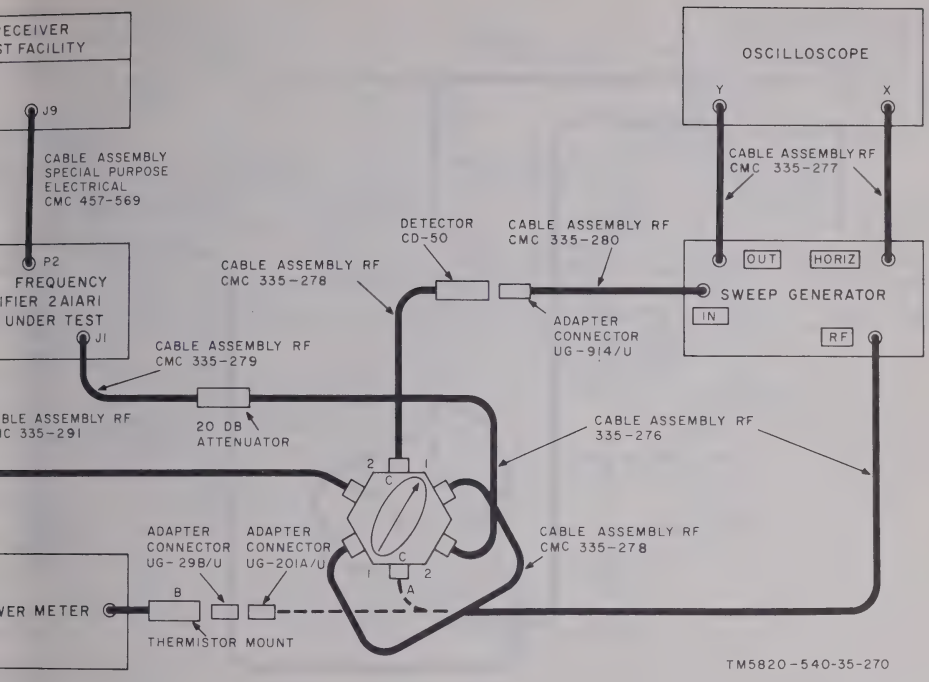
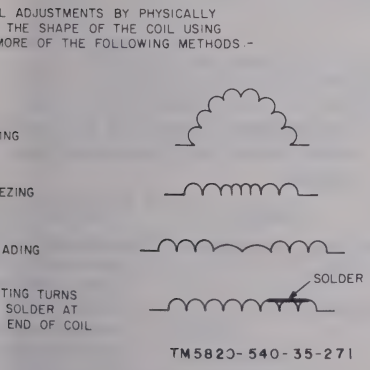


Figure 4-153. Radio frequency amplifier 2A1AR1 frequency response check, test set-up.



4-154. Radio frequency amplifier 2A1AR1 coil adjustment methods.

y two-thirds the height of the graticule. e resultant vswr curve between 220 MHz Hz.

Replace the calibrated mismatch con- the bi-directional coupler with the unit t (fig. 4-155D). The resultant vswr played on the oscilloscope at any fre- tween 220 MHz and 405 MHz should l that recorded in (*h*) above.

(*j*) Adjust C1 and L12 on unit under test to obtain the desired response.

(*k*) If it was necesasary to adjust C1 or L12 in (*j*) above, repeat the frequency response check described in (1) above. Do not readjust L12 or L2.

(*l*) Set switch S4 to OFF.

(3) *Noise figure.*

(*a*) Connect the test equipment as shown in figure 4-156.

(*b*) Set the test facility switches as follows:

Switch	Position
S4	ON
S6	Away from the OFF position
S7	MAN

(*c*) Set the GAIN controls on the test facility RF AMPLIFIER-MIXER CONVERTER ASSY and TUNER RADIO FREQ. sections of the test facility to mid-range.

(*d*) Set the tunable filter to 220 MHz.

(*e*) Set the signal generator frequency to 250 MHz at a level of 0 dbm.

(*f*) Set the noise generator output to zero.

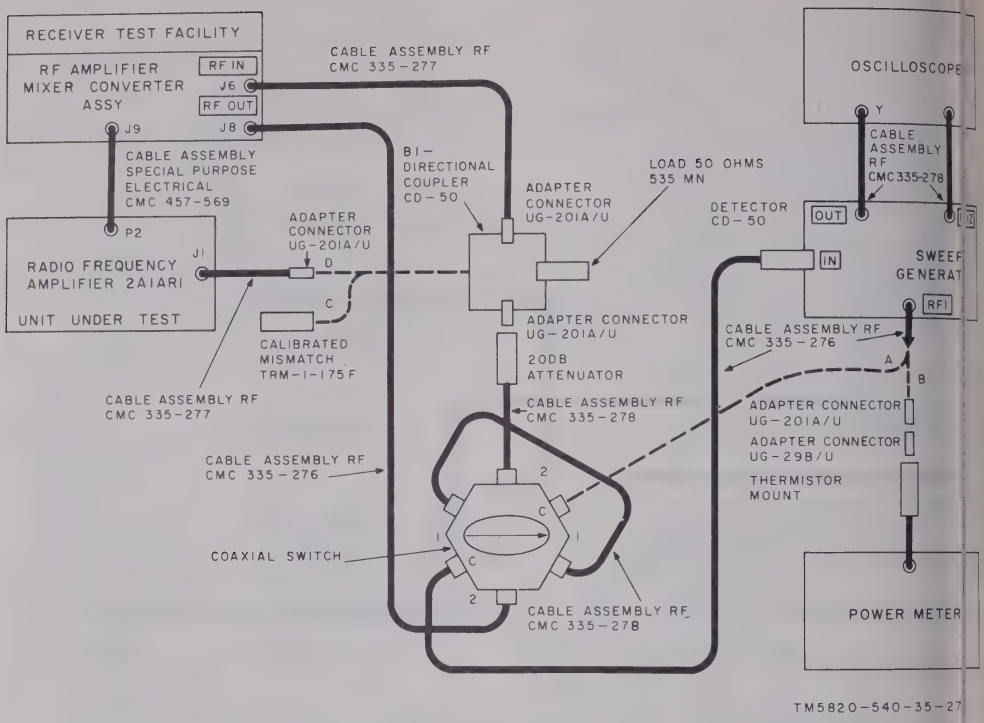


Figure 4-155. Radio frequency amplifier 2A1AR1, vswr check, test set-up.

(*g*) Carefully peak the tunable filter and the signal generator frequency for a maximum indication on the power meter.

(*h*) On the test facility, set the GAIN control on the RF AMPLIFIER MIXER CONVERTER ASSY section fully clockwise and adjust the GAIN control on the TUNER RADIO FREQ. for an indication of –12 dbm on the power meter.

(*i*) Reduce the GAIN control on the RF AMPLIFIER MIXER CONVERTER ASSY by 3 db until the power meter indicates –15 dbm.

(*j*) Increase the output level of the noise generator by 3 db as indicated on the power meter. The noise figure, which should not exceed 6 db, is read directly from the noise generator scale.

(*k*) Repeat steps (*c*) through (*j*) above for frequencies of 300 MHz and 405 MHz.

c. Troubleshooting (fig. 620).

CAUTION

Do not test Q1 and Q2 for an open or short using the multimeter resistance ranges.

Symptom	Checks and corrective measures
Gain below normal or no output.	Measure the dc voltages as shown in *d* below to isolate defective stage.
Poor vswr	Check for poor connection or cold solder joint at input connector J1 (fig. 4-157) or E4.
Poor frequency response	Perform the tests and adjustments described in *b*(1) above.
Poor noise figure	Replace Q1.

d. Typical DC Voltage with No Input Sig (fig. 4–158).

Transistor	Volts dc referenced to ground		Collector
	Emitter	Base	
Q1	+0.38	0	7.58
Q2	+0.36	0	7.58
Q3	-0.73	0	9.2
Q4	-0.74	0	9.2

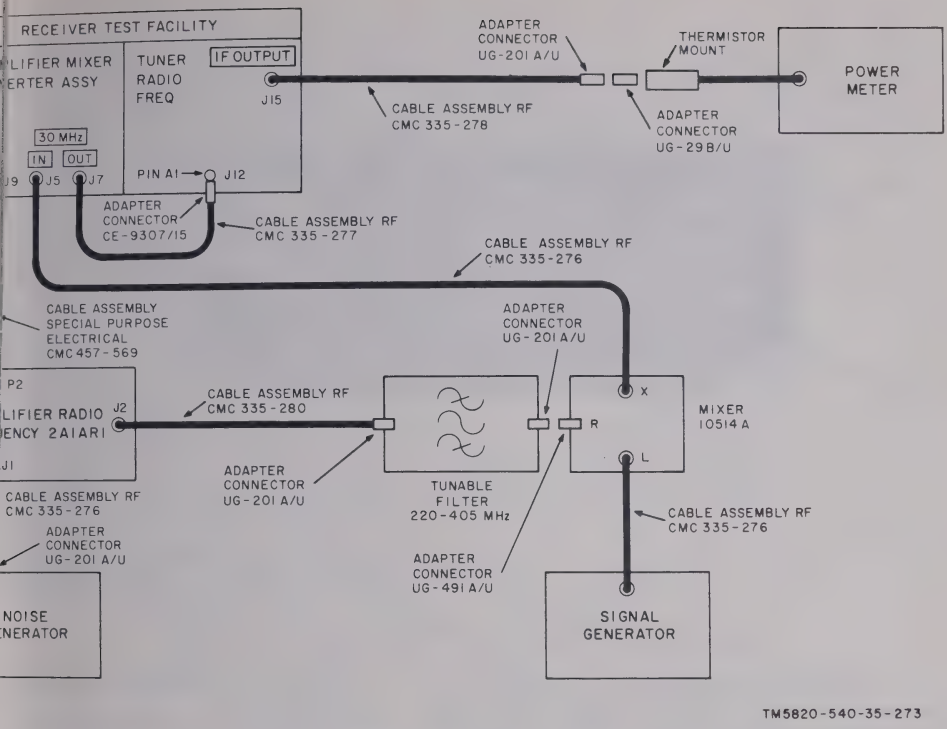


Figure 4-156. Radio frequency amplifier 2A1AR1 noise figure measurement test set-up.

Control-Indicator 2A2

indicator 2A2 is identical to control-indi-A3. Refer to paragraph 4–32 for testing, hooting, and adjustment procedures.

Electronic Switch 2A4

t Equipment and Material Required.

Equipment	Common Name
acility, Receiver 2867(V)1/ M-95(V)	Receiver test facility
sory Kit, Test ilities Set -1173(V)1/ M-95(V)	Accessory kit
ator, Sweep nal AN/USM-203	Sweep generator
tor, Standing ve Ratio /UPM-108	VSWR amplifier
meter AN/URM-98	Power meter
oscope AN/USM-281	Oscilloscope
ator, Signal /USM-44A	Signal generator
meter TS-352B/U	Multimeter

b. Test Procedure.

(1) *Insertion loss test.*

(*a*) Remove the top cover plate from the unit under test. Unsolder and disconnect the wire at E1 (fig. 4–159) and replace the plate.

(*b*) Connect the test equipment as shown in figure 4–160.

(*c*) Set the signal generator output frequency to 220 MHz at maximum output level; set the modulation to 50 percent at a frequency of 1 kHz.

(*d*) Set the variable attenuators to 0 db, and the coaxial switch to position 1.

(*e*) Set the test facility switches as follows:

Switch	Position
S1	ON
S17	+12V
S18	NORM
S19	INT

(*f*) Adjust the VSWR amplifier input control for a convenient indication on the VSWR amplifier meter.

(*g*) Set the coaxial switch to position 2 and note the VSWR amplifier meter indication.

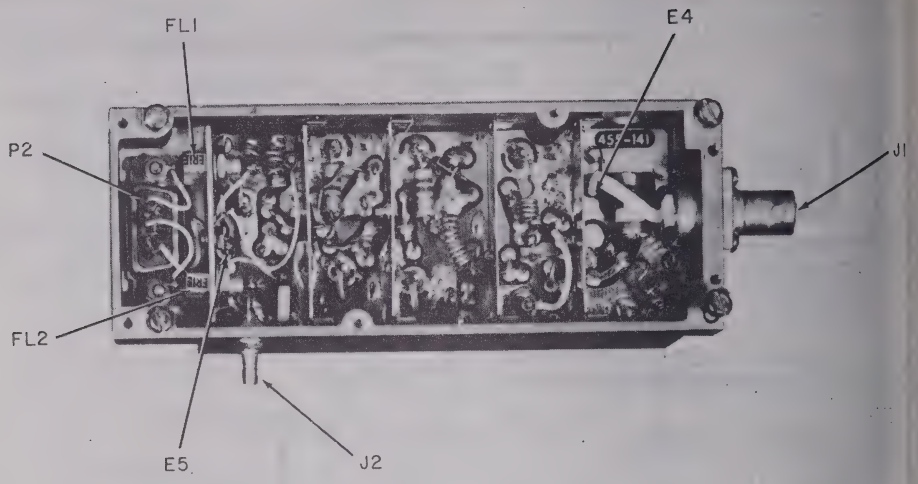


Figure 4-157. Radio frequency amplifier 2A1AR1, top cover removed.

(*h*) Reset the coaxial switch to position 1 and adjust the 0–1 db variable attenuator to obtain the same indication as that obtained in (*g*) above. The variable attenuator indication should not be greater than 0.75 db.

(*i*) Repeat (*c*) through (*h*) above at signal generator frequencies of 310 MHz and 405 MHz.

(2) *Isolation test.*

(*a*) Connect the test equipment as shown in figure 4–160.

(*b*) Set the signal generator output frequency to 220 MHz at +5 dbm output level; set the modulation to 50 percent at a frequency of 1 kHz.

(*c*) Set the variable attenuator to 50 db and the coaxial switch to position 1.

(*d*) Adjust the VSWR amplifier input control for a midscale indication on the VSWR amplifier meter and note this indication.

(*e*) Set the coaxial switch to position 2, set S18 to ALARM TEST and set the variable attenuator to 0 db. The VSWR amplifier meter indication should not exceed that obtained in (*d*) above.

(*f*) Repeat (*b*) through (*e*) above for signal generator frequencies of 310 MHz and 405 MHz.

(*g*) Set S17 to OFF and S18 to

(3) *Vswr test.*

(*a*) Connect the test equipment as in figure 4–161A, using calibrated m TRM–1:1.40F.

(*b*) Adjust the output level and width controls of the sweep generato flat response over the frequency range MHz to 405 MHz. Record the distance the baseline and the vswr curve displaye oscilloscope.

(*c*) Replace the calibrated m TRM–1:1.40F with calibrated mismatch 1.2.00F.

(d) Record the distance between t line and the vswr curve displayed on the scope.

(*e*) Replace the calibrated mismat 1–2.00F with electronic switch 2A4 (g. 161B).

(*f*) Set S17 to +12v.

(*g*) Sweep the sweep generator from 220 MHz to 405 MHz. The resultan displayed on the oscilloscope should not that recorded in (*b*) above.

(*h*) Set S18 to ALARM TES ALARM TEST lamp should light and scope curve should not exceed the level in (*d*) above between 220 and 405 MH

(*i*) Set S17 to OFF and S18 to

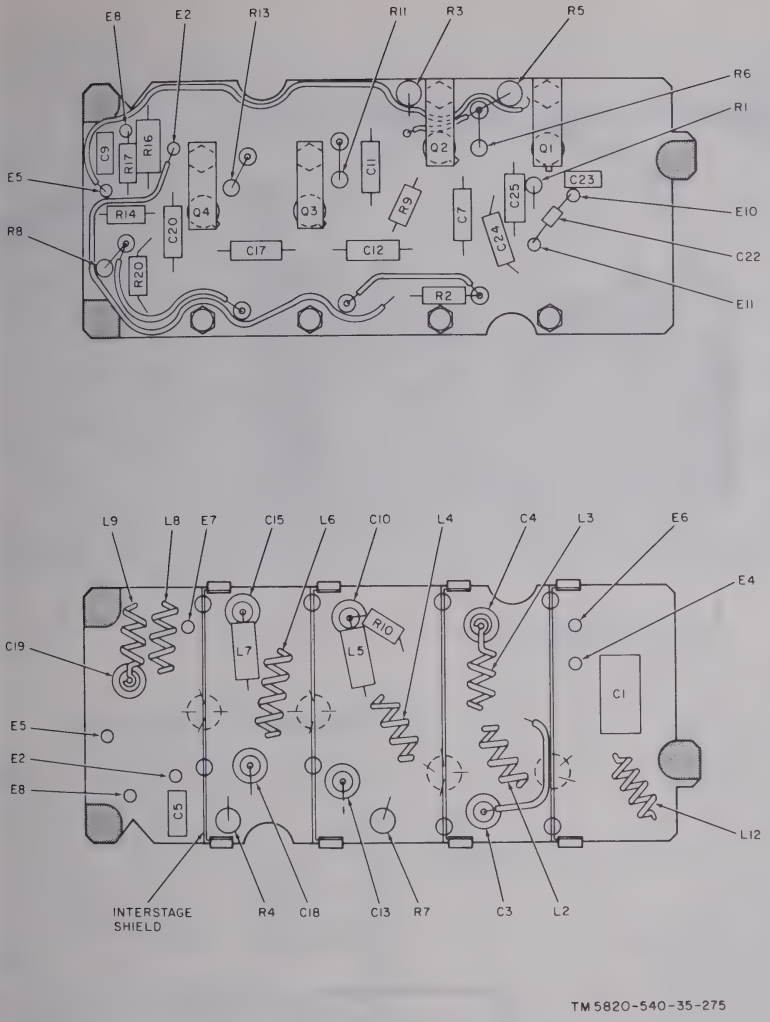


Figure 4-158. Radio frequency amplifier 2A1AR1AR1, parts location.

Power monitoring test.

CAUTION

sure test facility switch S17 is before carrying out the next step.

) Remove the top cover plate from the r test. Resolder the wire at E1 which nnected in *b*(1)(*a*) above. Replace the e.

) Connect the test equipment as shown 4-162.

) Set the signal generator output fre- 300 MHz CW at a level of less than

(*d*) On electronic switch 2A4, turn R2 (fig. 4-163) fully counterclockwise.

(*e*) Set S17 to +12V.

(*f*) Increase the output level of the signal generator to -2 dbm.

(*g*) On electronic switch 2A4, turn R2 clockwise until the test facility ALARM TEST lamp lights. The power meter indication should decrease, and further increase of the signal generator level should not cause the power meter indication to increase.

(*h*) Check the setting of R2 by decreasing the signal generator output level to less than -30 dbm, then increasing it again. The test facility

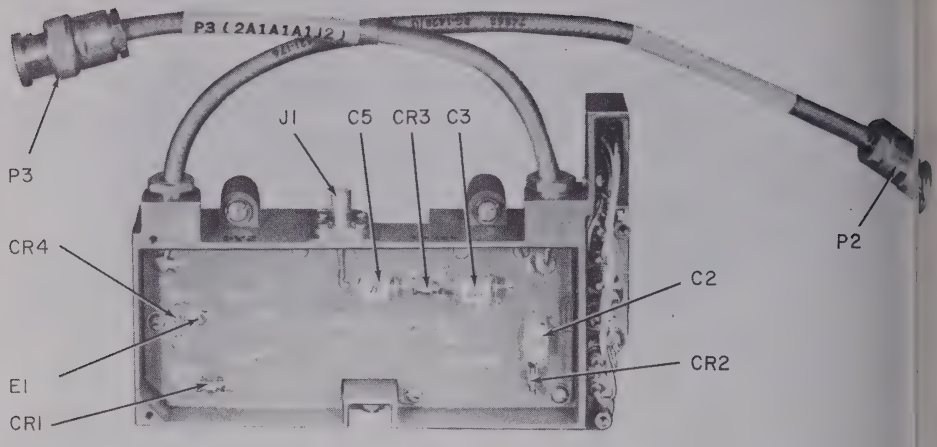


Figure 4-159. Electronic switch 2A4, top cover removed.

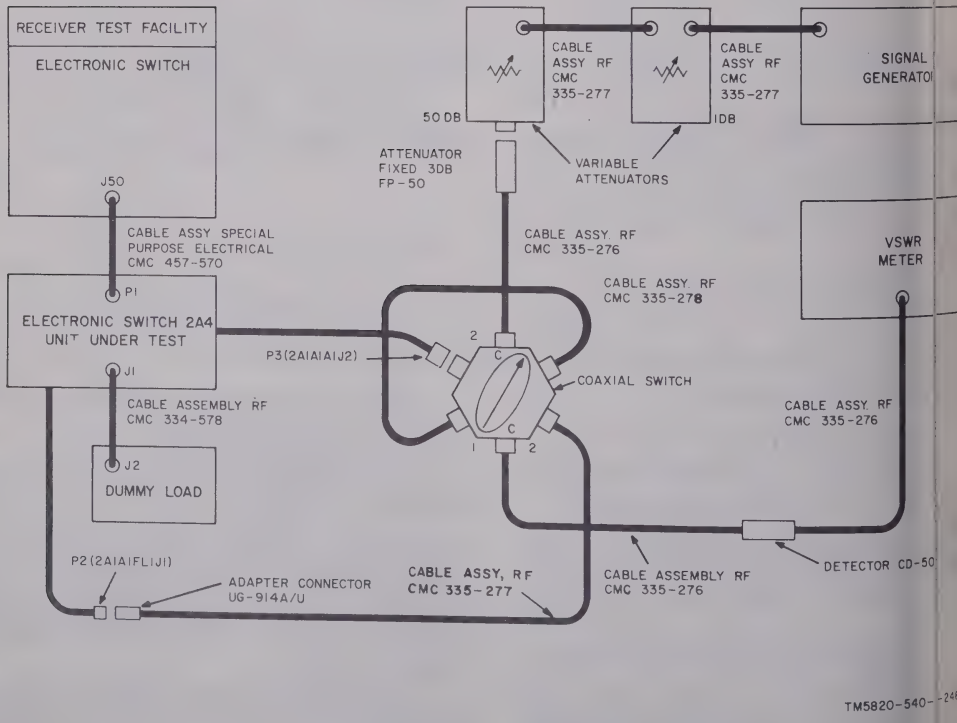


Figure 4-160. Electronic switch 2A4, insertion loss and isolation checks test set-up.

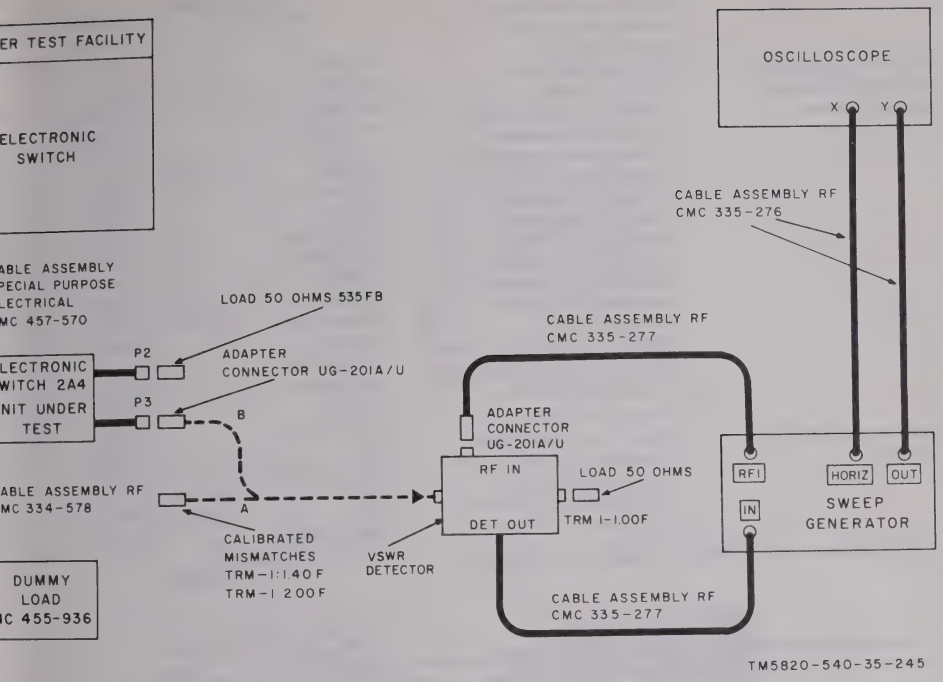


Figure 4-161. Electronic switch 2A4, vswr check, test set-up.

TEST lamp should light when the signal level reaches –2 dbm.

) Decrease the signal generator output ess than –30 dbm.

) Interchange the dummy load and the eter as follows: connect a 50-ohm load d connect the thermistor mount to J1 propriate adapters.

) Increase the signal generator output il the test facility ALARM TEST lamp ts. The power meter indication should rom zero to –8 dbm the moment the TEST lamp lights.

ubleshooting (fig. 6–19).

Symptom	Checks and corrective measures
from P2 with below alarm LARM TEST test facility	*a.* Measure voltage between **E9(+) and E8(–) on circuit board 2A4A1 (fig. 4-165)** It should be approximately 6 volts dc. If normal, unsolder and disconnect wire at E9 of circuit board 2A4A1 (fig. 4-165). Connect multimeter between E9 (+) and wire which was removed (–) and measure the current. It should be greater than 50 ma; if not, check CR1 and CR2 of circuit board 2A4A1. (fig. 4-159). *b.* C1, C2, or C4 defective. (fig. 4-159). *c.* If voltage measurement taken at *a* above is abnormal measure voltages at Q2, Q3, and Q4 as shown in *d* below to isolate defective stage.
No output from P2 with input rf below alarm level. ALARM TEST lamp on test facility on.	Measure the voltage at A1 and Q1 (fig. 4-164) to isolate defective stage (*d* below).
No switching into protection mode (rf path P3 and J1) when input rf exceeds alarm level.	Measure the voltage at A1 and Q1 to isolate defective stage (*d* below).
No output at J1 when switch is in protection mode (*b*(4) above).	Measure the resistance between E11 (–) and E10 (+) on circuit board 2A4A1. It should be approximately 800 ohms.

Symptom	Checks and corrective measures
	Reverse test leads and resistance should be close to infinity.
High swr (*b*(2) above) and/or high insertion loss (*b*(1) above).	*a.* Disconnect the wire at E9 of circuit board 2A4A1. Connect multimeter between E9 (+) and wire which was removed (–) and measure the current. It should be greater than 50 ma. If less than 50 ma check components which are in series with E1 and E5 of circuit board 2A4A2. **and E8 (2A4A1). Replace as required.**
	b. C1, C2, or C4 defective (fig. 4-159).
Poor isolation (*b*(3) above).	Measure the current as described in *a* above. It should be zero. If other than zero, CR1 or CR2 may be defective.

d. Typical DC Voltage Indications (fig. 4–164).

Mode of operation Check point	Normal mode (volts dc)	Protec mode (v dc)
A1 pin 2	–1.25	–15
A1 pin 3	–1.23	–11
A1 pin 4	–5.16	–16
A1 pin 7	–2.24	+15
A1 pin 8	+12.0	+11
A1 pin 1	0	
Q1 emitter	–2.9	+15
Q1 base	–2.24	+15
Q1 collector	12.0	+11
Q2 emitter	0	
Q2 base	–3.29	+1
Q2 collector	+159.30	+2
Q3 emitter	+157.80	+2
Q3 base	+158.0	+2
Q3 collector	+158.0	+8
Q4 emitter	+158.0	+2
Q4 base	+159.0	+2
Q4 collector	+158.0	+8
E1	+158.	+10
E2	+157.8	+10
E2 (+) to E8 (2A4A2)	+4.7	–8
E3 (2A4A1)	+199.0	+12
E8 (2A4A1)	+153.0	+8
E11 (+) to E10(–) (2A4A1)	+0.2	+27

NOTE

Measurements are taken between check point and ground unless otherwise specified.

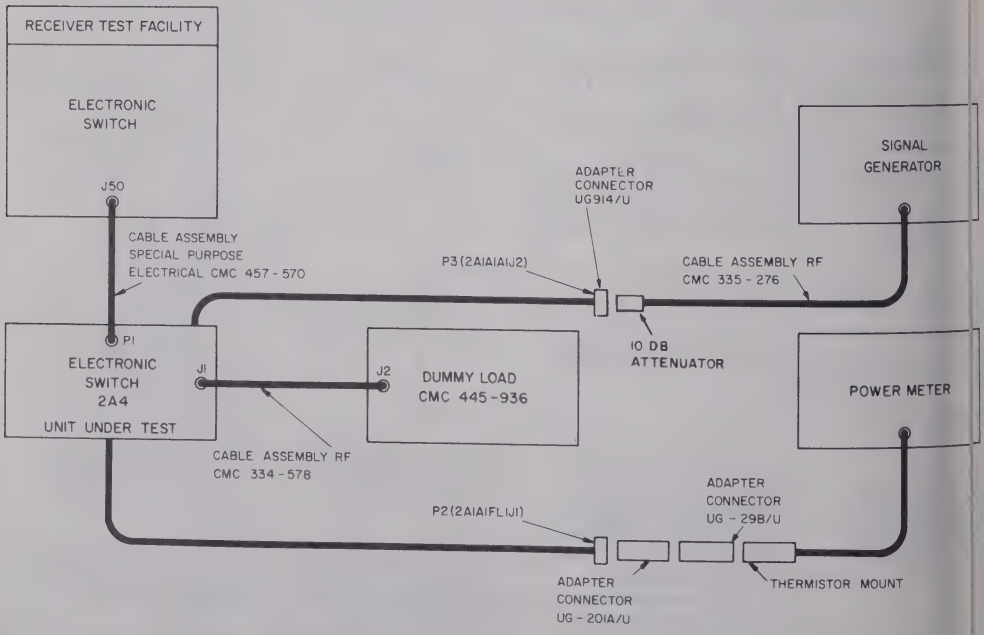


Figure 4-162. Electronic switch 2A4, power monitoring test set-up.

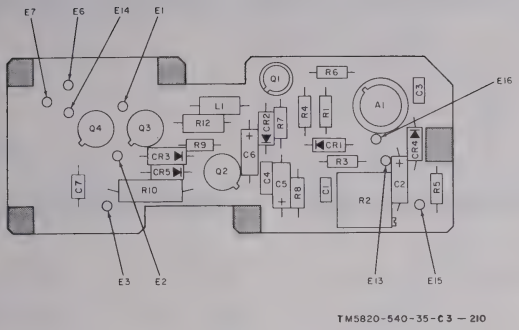


Figure 4-163. Electronic switch control 2A4A2, parts location.

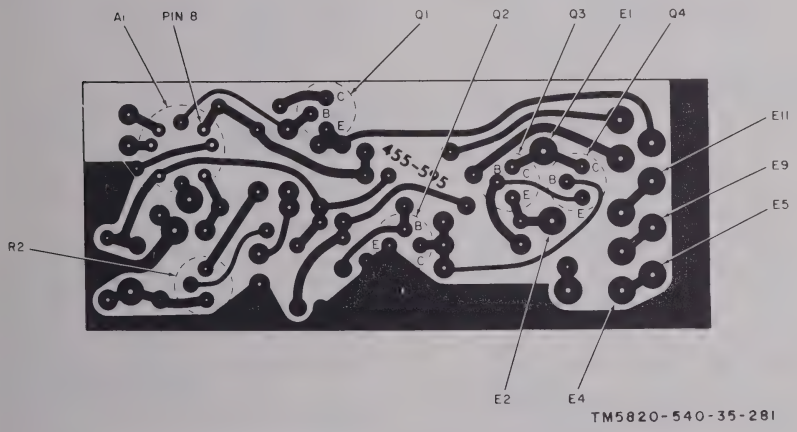


Figure 4-164. Electronic switch control 2A4A2, printed circuit board.

ower Supply 2PS1

t Equipment and Material Required.

Equipment	Common Name
Facility, ceiver -2867(V)1/ M-95(V)	Receiver test facility
ssory Kit, st Facilities Set K-1173(V)1/ M-95(V)	Accessory kit
meter, Electronic E-30A/U	VTVM

t Procedure.

Connect the test equipment as shown in -166.

(2) Set the test facility switches as follows:

Switch	Position
S5	S17
S19	EXT

(3) Observe the indications on test facility meter M1 for the following positions of switch S17.

S17 position	M1 indications
+12V	In green band
−12V	In green band
100V	Between 30% and 50% of full scale
200V	In green band
6V	In green band

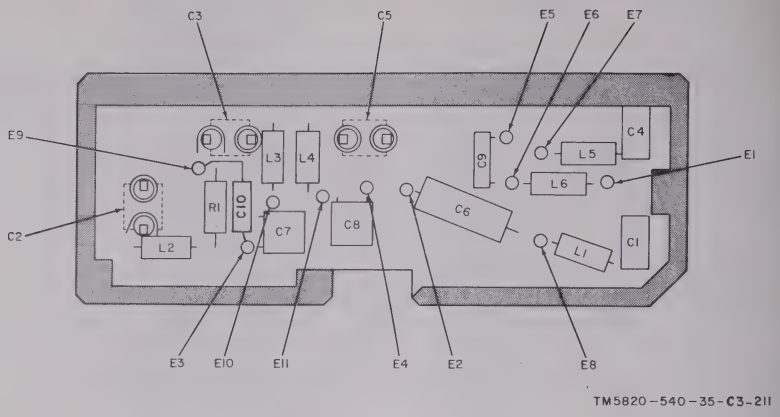


Figure 4-165. Electronic switch 2A4, parts location.

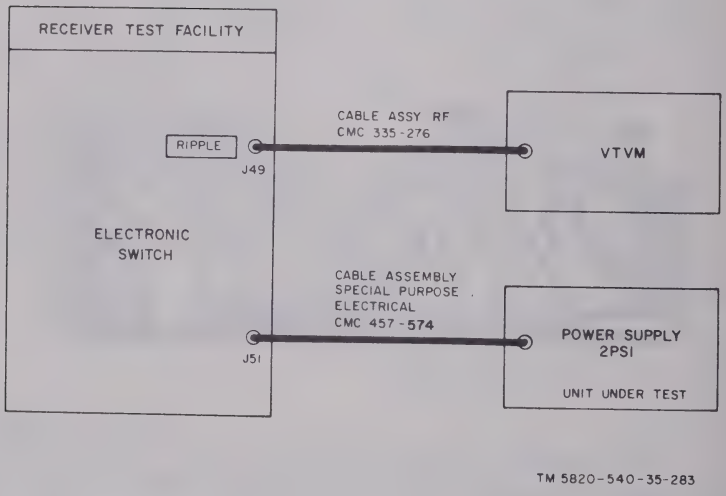


Figure 4-166. Power supply 2PS1 operational check test set-up.

(4) Set test facility switches S17 and S18 to their ALARM TEST position. The ALARM TEST lamp should light and meter M1 should indicate in the green band.

(5) Observe the ripple voltage on the VTVM for the following positions of switches S17 and S18.

Test facility switch positions S18	S17	VTVM indication (mv)
NORM	+12V	Less than 10
NORM	-12V	Less than 10
NORM	100V	Less than 15
NORM	200V	Less than 10
NORM	6V	Less than 20
ALARM TEST	ALARM TEST	Less than 250

c. Troubleshooting. This is an encapsulated module and cannot be repaired. Discard the unit if proven defective.

4-68. Receiver-Transmitter Order Wire RT-773/GRC-103(V)

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Transmitter TS-2867(V)1/ GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/	Accessory kit

Equipment	Common Name
M-95(V)	
ator, Signal /USM-205	Wide range oscillator
eter, Electronic -30A/U	VTVM
er, Electronic ital Readout /USM-207	Counter

st Procedure.

"E

telephone signal conver r 9A3 and assem- 9A4 as described in paragraphs 4–66 and

Connect the test equipment as shown re 4–167.

Set test facility switches S1 to ON and SET REF.

On the unit under test, the POWER ould light.

Disconnect the cable from test facility O RADIO) connector. The POWER lamp remain lit. Reconnect the cable to the test

Disconnect the cable from test facility ATCH THRU) connector. The POWER ould remain lit. Reconnect the cable to facility.

Set the wide range oscillator to 1 kHz cated on the counter and adjust the level dbm as indicated on the VTVM.

Set switch S31 to position A TO B and position B TO A. In both positions the should indicate –10 dbm ±0.2 db. A tone should be heard in the handset of t under test.

Set switch S31 to A TO B then B TO A. n.

Set the wide range oscillator to 1600 Hz , as indicated on the counter and adjust el to –10 dbm as indicated on the VTVM. unit under test the CALL lamp should nd the buzzer should sound.

Set BUZ OFF/ALM NORM switch S2 unit under test to BUZ OFF. The buzzer be silenced.

Set the BUZ OFF/ALM NORM switch ALM NORM.

Disconnect the cable from connector the test facility.

On the handset of the unit under test the PRESS-TO-TALK switch and speak ne microphone. You should be able to hear wn voice in the receiver of the handset. VTVM should indicate approximately –15 dbm, while you are speaking, for either the A TO B or B TO A position of switch S31.

(14) On the unit under test, press and hold the RING button, and set test facility switch S31 from posiiton A TO B to B TO A. The VTVM should indicate –10 dbm ± 1.0 db, in either A TO B or B TO A position of switch S31.

c. Troubleshooting Procedure. Refer to the troubleshooting chart in paragraph 3–7.

4–69. Distribution Panel 9A1

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V)	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) Using the multimeter, check resistances between the points listed below. Refer to figures 6–31 and 3–40.

Multimeter connected between	Resistance (ohms)
9A1J1 pin G and 9A1J1 pin K (R2)	620 ±5%
9A1J2 pin K and 9A1J2 pin G (R1)	620 ±5%
9A1J2 pin A and 9A1P1 pin 6	0
9A1J2 pin B and 9A1P1 pin 13	0
9A1J2 pin C and 9A1J3 pin 3	0

(2) Connect the test equipment as shown in figure 4–168.

(3) Set test facility switches S1 to ON and S31 to A TO B.

(4) Using the multimeter, check voltages between the points listed below. Refer to figure 6–31.

Multimeter connections (+)	(–)	Indication (v dc)
9A1P1 pin 6	9A1P1 pin 3	+26
9A1J3 pin A	9A1J3 pin B	+12

(5) Shortcircuit 9A1P1 pins 3 and 13. The buzzer should sound.

(6) Set test facility switches S31 and S1 to OFF.

(7) Connect the multimeter across 9A1TB1 pins 4 and 5. It should indicate infinity.

(8) Press the handset PRESS-TO-TALK switch; the multimeter should indicate zero.

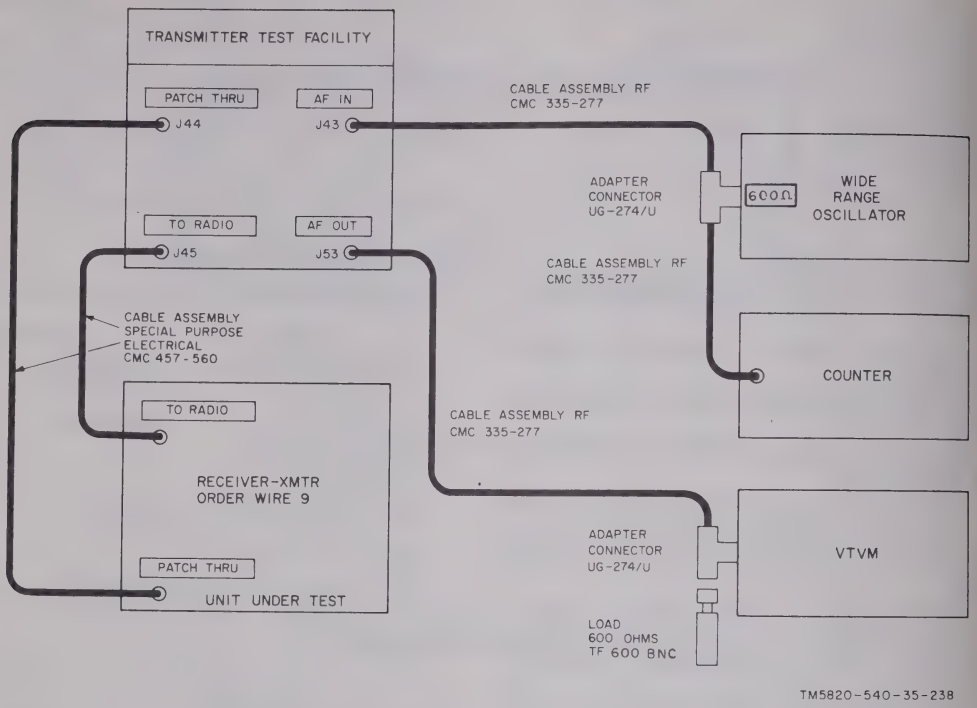


Figure 4-167. Order wire operational check, test set-up.

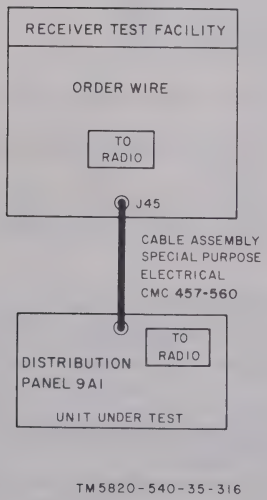


Figure 4-168. Distribution panel 9A1 test set-up.

(9) Release the handset switch; the multimeter indication should return to infinity.

(10) Repeat (8) and (9) above three times.

(11) Connect the multimeter to 9A1TB1 pins 2 and 3 and repeat (7) through (10) above.

c. Troubleshooting (fig. 6-31).

Symptom	Checks and corrective measures
Abnormal indication testing R1 and R2 (*b*(1) above).	Check resistors on resistor assembly 9A1A1 (fig. 3-39), across E1 and E2 for R1, and E3 and E4 for R2. Replace resistor as required.
Abnormal indication between 9A1J2 pins and 9A1P1 pins (*b*(1) above).	Check wiring between 9A1J2 and 9A1P1 to relay K1 contacts. If wiring is normal, replace relay K1.
Abnormal indication between 9A1J2 pin C and 9A1J3 pin A (*b*(1) above).	Check wiring between 9A1J2 pin C and 9A1J3 pin A to relay K2 contacts. If wiring is normal, replace relay K2.
Abnormal indication when checking voltage between 9A1P1 pin 6 to 9A1P1 pin 3 (*b*(4) above)	Check wiring between 9A1P1 pin 6 and pin 3 to relay K1 contacts. If wiring is normal, replace relay K1.
Abnormal indication when checking voltage between 9A1J3 pin A and 9A1J3 pin B (*b*(4)	Check wiring between 9A1J3 pin A and pin B to relay K2 contacts. If wiring is normal, re-

Symptom	Checks and corrective measures
above).	place relay K2.
uzzer 9A1DS1 does not sound (*b*(5) above).	Replace buzzer 9A1DS1.
bnormal indications when testing handset switch. (*b*(6) through (10) above).	Replace handset switch.

4–70. Monitor Panel 9A2

a. Test Equipment and Material Required.

Equipment	Common Name
Multimeter TS-352B/U	Multimeter

b. Test Procedure.

(1) Using the multimeter, check resistances o validate operation of switch 9A2S1 (fig. 3–38) s follows:

Multimeter connected between following S1 pins	Secondary action	Resistance (ohms)
7 and 2		infinity
7 and 2	press S1	0
7 and 1		0
7 and 1	press S1	infinity
6 and 3		infinity
6 and 3	press S1	0
6 and 4		0
6 and 4	press S1	infinity

(2) Using the multimeter check the operation of switch 9A2S2 as follows:

Connect multimeter between	Secondary action	Resistance (ohms)
9A2J2 pin 5 9A2J2 pin 3	S2 OFF	infinity
9A2J2 pin 5 9A2J2 pin 3	S2 ON	0
9A2J2 pin 5 9A2A1 E4	S2 OFF	200
9A2J2 pin 5 9A2A1 E4	S2 ON	0

c. Troubleshooting (fig. 6–31).

Symptom	Corrective measure
Abnormal indication (*b*(1) above).	Replace switch 9A2S1
Abnormal indication (*b*(2) above).	Replace switch 9A2A2

4–71. Telephone Signal Converter 9A3

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V)	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit
Generator, Signal AN/USM-205	Wide range oscillator
Multimeter, TS-352B/U	Multimeter
Counter, Electronic Digital Readout AN/USM-207	Counter

b. Test Procedure.

(1) *1,600-Hz tone generation.*

(*a*) Connect the test equipment as shown in figure 4–169.

(*b*) Set test facility switch S1 to ON and switch S32 to OSC. The VTVM should indicate 1.6v ±0.1v. On the unit under test, adjust gain control R13 (fig. 4–170) to obtain 1.6v ±0.1v indicated on the VTVM.

(*c*) The counter should indicate 1,600 Hz ±1 Hz. Adjust C4 on the unit under test to obtain the correct frequency.

(*d*) Set switch S32 to OFF.

(2) *1,600-Hz tone receive and sensitivity.*

(*a*) Connect the test equipment as shown in figure 4–171.

(*b*) Set test facility switch S32 to the RCVR position.

(*c*) Set the coaxial switch to position 1.

(*d*) Tune the wide range oscillator to 1,600 Hz ± 1 Hz, as indicated on the counter and adjust the output level to obtain a 200-mv indication on the VTVM.

(*e*) Set the coaxial switch to position 2. The VTVM should indicate 1.6v ± 0.1v. Adjust C2 on the unit under test for maximum indication on the VTVM, then adjust the R1 (sensitivity) control to obtain a 1.6v ±0.1v indication on the VTVM.

(*f*) Set the coaxial switch to position 1.

(g) Adjust the output level of the wide range oscillator to 50 mv as indicated on the VTVM.

(*h*) Set test facility switch S32 to the ALARM position.

(*i*) Slowly increase the output level of the wide range oscillator until the order wire ALARM lamp on the test facility illuminates. The VTVM should indicate 108 mv ± 5 mv.

NOTE

If the required voltage in (i) above is not obtained readjust the R1 control on the module under test and repeat (*f*) through (*i*) above until the correct voltage indication is obtained.

c. Troubleshooting (fig. 6–30).

Symptom	Checks and corrective measures
Test (1) above: no output	Measure the voltage across CR1 (fig. 4-170); the

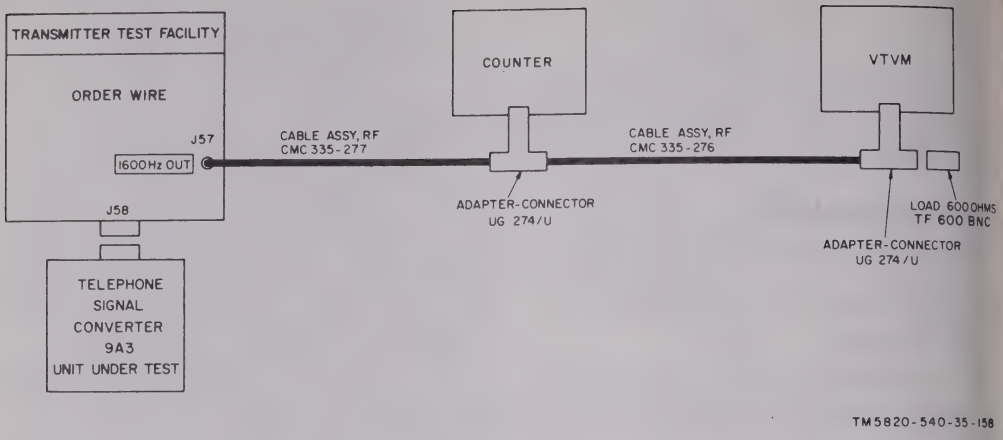


Figure 4-169. Telephone signal converter 9A3, 1,600 Hz tone generation test set-up.

Symptom	Checks and corrective measures	Symptom	Checks and corrective measures
	multimeter should indicate +10v dc. If abnormal indication, check CR1 for shortcircuit; replace if necessary.		of Q1 stage to FL1 pin 3, as described in *d* below. Check continuity of FL1. Replace as required.
	Using a VTVM measure the signal voltages of transistor stages Q2 through Q4 and TP2, as described in *d* below.	Step (*i*): order wire ALARM lamp does not come on.	Measure the voltage of stage Q5 as described in *d* below.
Low output: frequency beyond specified limits.	Check C4 and FL2; replace if necessary.		Check the operation of relay K1. If Q5 voltages are normal, K1 contacts may be open with the relay operated. In this case, replace K1.
Test (2) above: step *e* no output reading	Check continuity of R1, replace if necessary.		
	Measure the signal voltage		

d. Voltage Measurements (with 1.6 KHz signal input at 200 mv).

Test point	Typical indication (v rms unless otherwise indicated)	Probable cause	Checks and corrective measures
Q2-base	1.9	Faulty Q2 stage, or shorting feedback capacitor C3.	Check circuit resistance to determine faulty component; replace as required.
FL2-pin 3	1.9		
Q3-emitter	1.9	Faulty Q3 stage	Replace if necessary.
TP2	1.6	Faulty Q4 stage or R13 open circuit.	Check R13 resistance. Replace as required.
Q1-base	0.080	Faulty Q1 transistor	Replace transistor.
-collector	1.0		
FL1-pin 3	0.325	Faulty FL1 or C2	Replace component as required.
Q5-TP3 (TF S32 set to ALARM)	1.6		
Q5-collector	5.3 v dc	Faulty Q5 transistor or relay K1.	Check continuity of relay K1 and resistances of Q5; replace component as required.

4-72. Amplifier Assembly 9A4

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Transmitter	Transmitter test facility

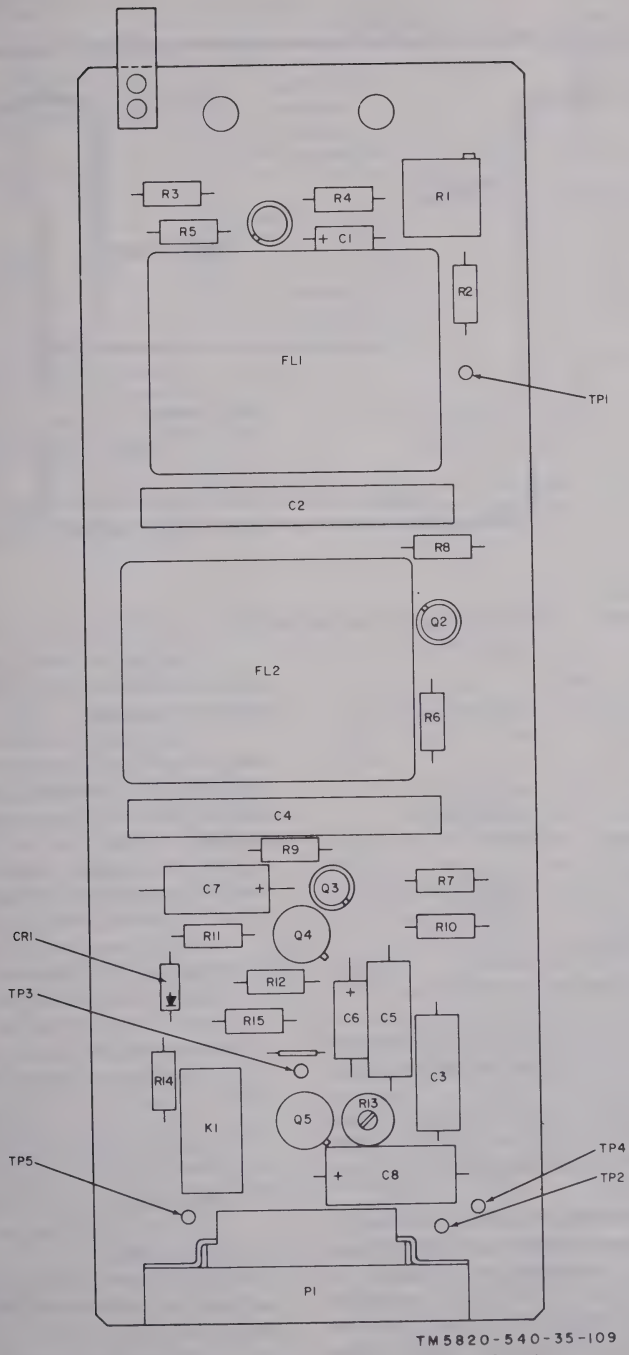


Figure 4-170. Telephone signal converter 9A3, parts location.

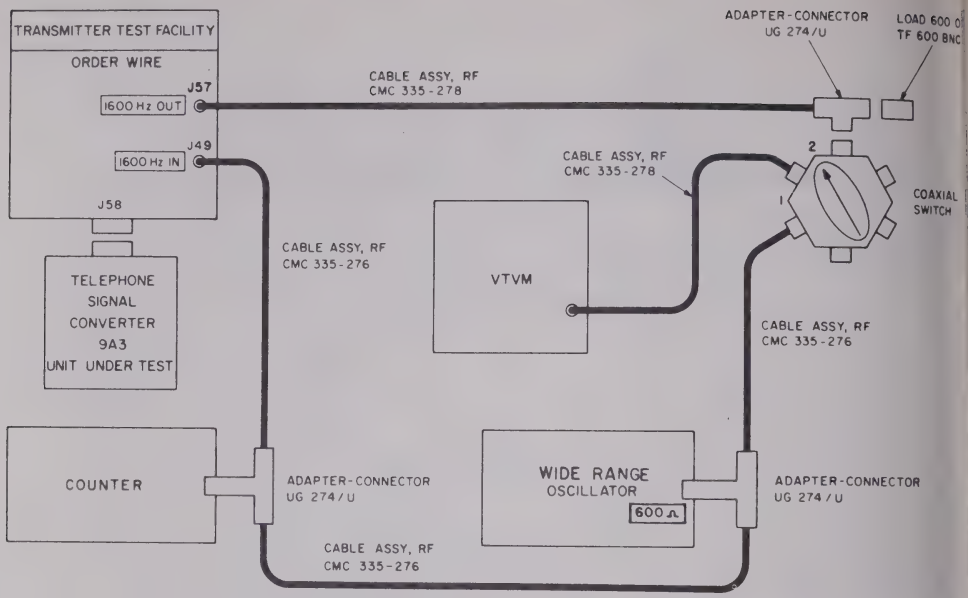


Figure 4-171. Telephone signal converter 9A3, 1,600 Hz tone receive checks, test set-up.

Equipment	Common Name
TS-2866(V)1/ GRM-95(V)	
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit
Generator, Signal AN/USM-205	Wide range oscillator
Voltmeter, Electronic ME-30A/U	VTVM
Indicator, Distortion TS-1344/U	Distortion analyzer

b. Test Procedure.

(1) *REC A to TR B thru path*

(*a*) Connect the test equipment as shown in figure 4–172A.

(*b*) Set switch S1 (fig. 4–173) on the unit under test to the PCM position and set the coaxial switch to position 1.

(*c*) Set the wide range oscillator to 1 kHz at a level of –10 dbm as indicated on the VTVM.

(*d*) Set test facility switch S1 to ON and S32 to the OSC position.

(*e*) Set the coaxial switch to position 2.

(*f*) On the unit under test, adjust control R7 (Level A) to obtain an indication of –10 dbm ± 1.0 db on the VTVM. The distortion analyzer should indicate less than –40 dbm (less than 1 percent distortion). Record this indication.

(*g*) Set switch S1 on the unit under test to the FDM position. The VTVM should indicate some noise.

(*h*) Return switch S1 on the unit under test to the PCM position.

(*i*) Set the coaxial switch to position 1 and set the wide range oscillator to 200 Hz at a level of –10 dbm.

(*j*) Set the coaxial switch to position 2. The VTVM should indicate within +0.5 db to –1.0 db of the level recorded in (*f*) above.

(*k*) Repeat steps (*i*) and (*j*) above at 500 Hz, 1.5 kHz, and 2 kHz.

(2) *REC B to A thru path*

(*a*) Connect the test equipment as shown in figure 4–172B.

(*b*) Repeat steps (*b*) through (*k*) of (1) above.

NOTE

In step (*f*) above, adjust R18 (Level B) control, instead of R7.

(3) *Handset to TR B transmit path.*

(*a*) Connect the test equipment as shown in figure 4–172C.

(*b*) Set the coaxial switch to position 1 and set the wide range oscillator to 1 kHz at a level of +4 dbm.

(*c*) Set the coaxial switch to position 2. The VTVM should indicate –10 dbm ± 1.0

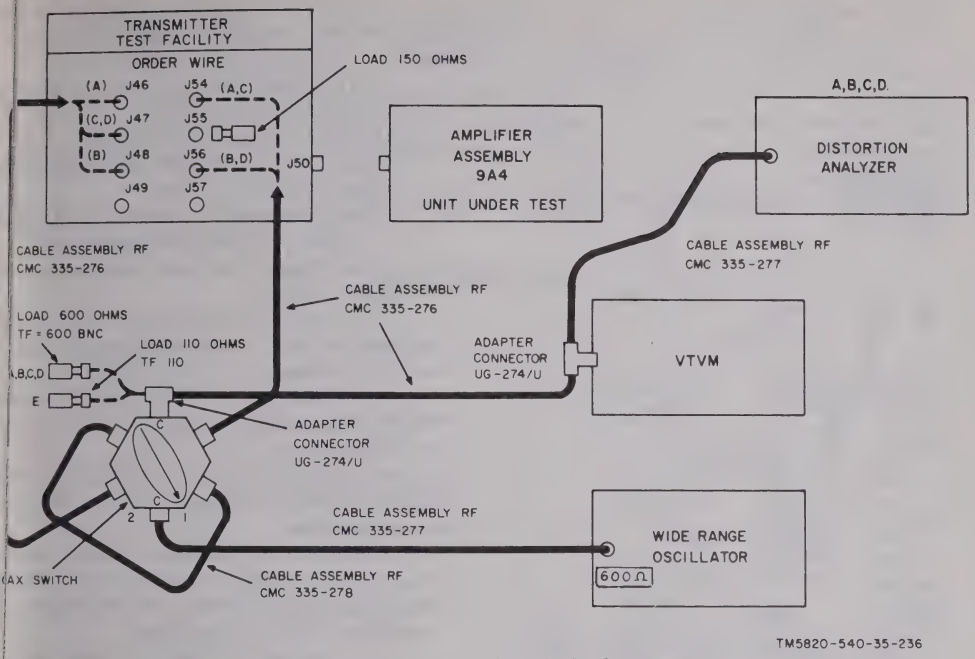


Figure 4-172. Order wire through circuit, test set-up.

Record this level. The distortion analyzer should indicate less than –24 dbm (less than 2 percent distortion).

(*d*) Set the coaxial switch to position 1 and set the wide range oscillator to 200 Hz at a level of +4 dbm.

(*e*) Set the coaxial switch to position 2. The VTVM should indicate **within +0.5 and -1 db of** the level recorded in (*c*) above.

(*f*) Repeat (*d*) and (*e*) above at 250 Hz and 500 Hz.

(*g*) Set the coaxial switch to position 1 and set the wide range oscillator to 1.5 kHz at a level of +4 dbm.

(*h*) Set the coaxial switch to position 2. The VTVM should indicate no more than –1.0 db below the level recorded in (*c*) above.

(*i*) Repeat (*g*) and (*h*) above at 2 kHz.

(*j*) Set the coaxial switch to position 1 and set the wide range oscillator to 1 kHz at a level of +4 dbm.

(*k*) Set the coaxial switch to position 2. The VTVM should indicate **between 9 db and 11 db below the level recorded in (C) above. Record this level.**

(*m*) Set the coaxial switch to position 2. The VTVM should indicate between 9 db and 10 db higher than the level obtained in (*k*) above.

(*n*) Set the coaxial switch to position 1.

(*o*) Transfer the cable from the 600-ohm output of the wide range oscillator to the 50 ohm output of the wide range oscillator and replace the 600-ohm load on the VTVM with the 110-ohm load provided as shown in figure 4–172E.

(*p*) Set the wide range oscillator to a level of 1.85 v.

(*q*) Set the coaxial switch to position 2.

(*r*) Replace the 110-ohm load on the VTVM with the 600-ohm load. The VTVM should indicate between 12 db and 16 db above the level obtained in (*k*) above.

(4) *Handset to TR A transmit path.*

(*a*) Connect the test equipment as shown in figure 4–172D.

(*b*) Repeat (*b*) through (*r*) of (3) above.

(5) *REC A to TRA crosstalk.*

(*a*) Connect the test equipment as shown in figure 4–174A.

(*b*) Set the coaxial switch to position 1 and set the wide range oscillator to 40 Hz at a level of –10 dbm.

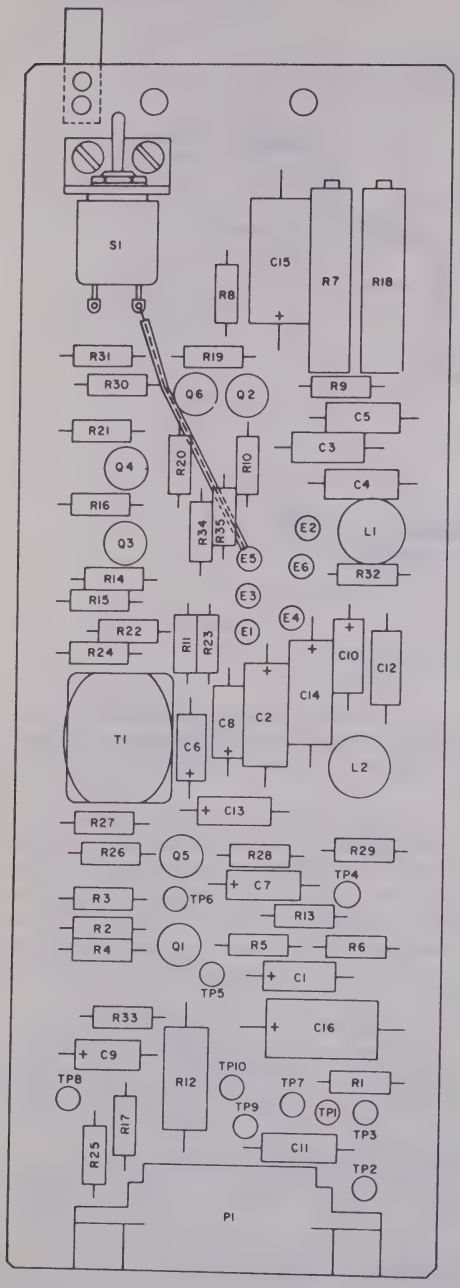


Figure 4-173. Amplifier assembly 9A4, parts location.

(*c*) Set the coaxial switch to posit 2. The VTVM indication should not exceed 45 dbm.

(*d*) Repeat steps (*b*) and (*c*) above 200 Hz, 1 kHz, 2 kHz, and 4 kHz.

(6) *REC B to TR B crosstalk.*

(*a*) Connect the test equipment as shown in figure 4–174B.

(*b*) Repeat (*b*) through (*d*) of (5) above.

(7) *REC A to handset receive path.*

(*a*) Connect the test equipment as shown in figure 4–174C.

(*b*) Set the coaxial switch to posit 1 and set the wide range oscillator to 1 kHz at a level of –10 dbm.

(*c*) Set the coaxial switch to positi 2. The VTVM should indicate –29.4 dbm ±1 db. Record this level.

(*d*) Set the coaxial switch to posit 1 and set the wide range oscillator to 200 Hz at a level of –10 dbm.

(*e*) Set the coaxial switch to positi 2. The VTVM should indicate no more than db below the level obtained in (*c*) above. (e.g. –29.4 dbm –1 db = –30.4 dbm).

(*f*) Repeat (*d*) and (*e*) above at 25 Hz and 500 Hz.

(*g*) Set the coaxial switch to position 1 and set the wide range oscillator to 1.5 kHz at a level of –10 dbm.

(*h*) Set the coaxial switch to positi 2. The VTVM should indicate no more than +0 db above the level obtained in (*c*) above.

(*i*) Repeat (*g*) and (*h*) above at 2 Hz.

(*j*) Disconnect the 150/600 adapter and connect the cable from connector J57 of the test facility to coaxial switch pole B2.

(*k*) Set the coaxial switch to position 1 and set the wide range oscillator to 1.5 kHz at a level of –10 dbm.

(*l*) Set the coaxial switch to positio 2. The VTVM should indicate 100 mv ±20 mv.

(8) *REC B to handset receive path.*

(*a*) Connect the test equipment as shown in figure 4–174D.

(*b*) Repeat (*b*) through (*l*) of (7) above.

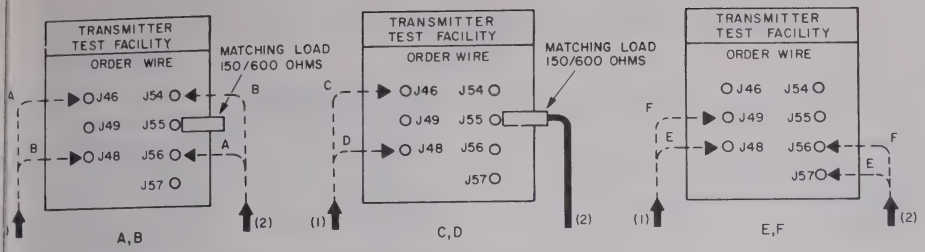
(9) *Sidetone tests.*

(*a*) Set up the test equipment as shown in figure 4–175.

(*b*) Set the coaxial switch to position 1 and set the wide range oscillator to 1 kHz at an output level of 330 mv as indicated on the VTVM.

(*c*) Set the coaxial switch to position 2.

(*d*) Remove the 110-ohm load from the VTVM. The VTVM should indicate 25 mv ±7 mv.



DETAIL CONNECTIONS

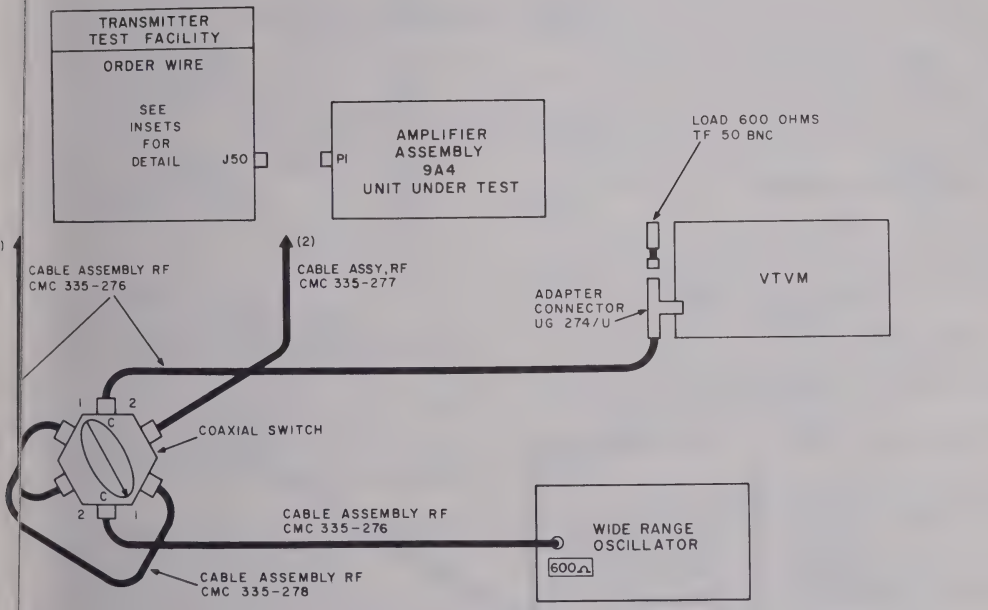


Figure 4-174. Order wire crosstalk measurement, test set-up.

c. Troubleshooting (fig. 4–173).

NOTE

Measurements are taken between the check point and ground.

Check point	Normal indication (mv rms unless otherwise indicated)	Defective component probable cause of abnormal indication
	Break in the A to B signal path	
Q1 base	245	C1
Q1 emitter	230	Q1, R2, R3, R4, R5, R6
Q2 emitter	10	C2, S1A
Q2 base	2.6 volts dc	R30, R31
Q2 collector	300	Q2, R7, R8, R9
TP3	245	L1, C3, C4, C5

Check point	Normal indication (mv rms unless otherwise indicated)	Defective component probable cause of abnormal indication
	Break in the B to A signal path	
Q5 base	245	C13
Q5 emitter	230	Q5, R26, R27, R28, R29,
Q6 emitter	10	C14, S1B
Q6 base	2.6 volts dc	R30, R31
Q6 collector	300	Q6, R11, R19, R32
TP9	245	L2, C10, C11, C12
	Break in REC A or REC B to signal path	
TP6	350	Q1 or Q5 stage
TP7	100	T1
	Break in microphone to TR A signal path	
Q4 base	160	C8, R15
Junction C10 and R20	230	Q4, R21, R20
TP9	245	L2, C10, C11, C12
	Break in microphone to TR B signal path	
Q3 base	160	C8, R15
Junction C3 and R10	230	Q3, R10, R16
TP3	245	L1, C3, C4, C5

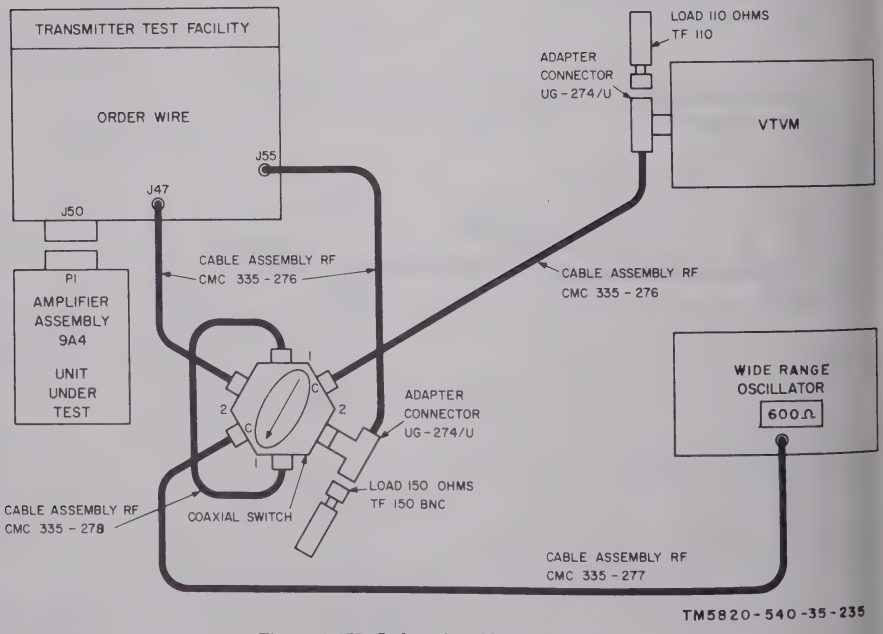


Figure 4-175. Order wire sidetone test set-up.

Section III. RADIO SET ALIGNMENT PROCEDURES

73. Transmitter Radio T-983(P)/ GRC-103(V) and Amplifier-Frequency Multiplier AM-4320/ GRC-103(V) Tests and Alignment

a. Test Equipment and Material Required.

Equipment	Common name
est acility, Transmitter TS-366(V)1/GRM-95(v)	Transmitter test facility
ccesory Kit, Test Facities Set MK-1173(V)1/ GR -95(V)	Accessory kit
oltmter Electronic ME-30A/U	VTVM
igna Generator AN/USM-205	Wide range oscillator
igna Generator AN/USM-44A	Signal generator
elec ve Voltmeter AN/USM-306	Level meter
Vatt eter AN/URM-120	Wattmeter
oun r, Electronic, Digital Re out AN/USM-207	Counter
Iult eter TS-352B/U	Multimeter
ndic or, Distortion TS-1344/U	Distortion analyzer
able Assembly, Special Pu ose, Electrical CMC 217-800010 (fig 5-18)	
hort ircuit Plug Microlabs TS MC	Shortcircuit plug

b. Test Procedures.

(1) Preliminary operational checks.

(a) Connect the test equipment as shown in gu 4-176.

(b) Set the voltage control on the power upply (part of the necessary kit) to 115v ac.

(c) Set the unit under test AC POWER switch o ON/RESET. Observe the following on the unit nde test:

1. Buzzer may sound; press BUZZER OFF with to silence the buzzer.

2. Blower should operate.

3. AC POWER lamp should light.

4. If the SYNC alarm lamp lights, it should xti guish within 10 sec.

5. LOW POWER alarm lamp should light.

6. OVERHEAT lamp lights but should xti guish after 10 seconds.

7. Momentarily impede the air flow through he ir filter by *completely* covering the intake with a he of paper. The OVERHEAT lamp should light nd the buzzer should sound within 10 seconds. m ediately remove the obstruction to the air flow; he OVERHEAT lamp should go out and the buzzer hd ld be silent within 10 seconds.

(d) Check the unit under test meter in- ic ions at the following meter selector switch os tions:

wi position	Typical indication
2V	In the green band
8V	In the green band
60(	In the green band
OS	20% to 90% full scale

(e) On the unit under test, set the XMTR CHANNEL and XMTR TUNE controls to channel 50.

(f) Check the unit under test meter indications at the following meter selector switch positions:

Switch position	Typical indication
DOUBLER	20% to 90% of full scale
MULT	20% to 90% of full scale

(g) Set the meter selector switch to DRIVER. Push in the PWR OUT PEAK knob, and tune for maximum meter indication. The unit under test meter should indicate 20 to 90 percent of full scale.

(h) Set the meter selector switch to PWR OUT. Pull out the PWR OUT PEAK knob, and tune for maximum meter indication. The unit under test meter should indicate 20 to 90 percent of full scale. If the indication is greater than 100 percent of full scale, observe the wattmeter for maximum indication.

(i) The unit under test LOW POWER lamp should go out and the buzzer should sound. Press the BUZZER OFF pushbutton to silence the buzzer.

NOTE

The unit under test XMTR TUNE control can be readjusted slightly (not to exceed ½-inch movement on the XMTR TUNE tape) to peak the meter indications.

(j) Set the AC POWER switch to the OFF position.

(k) Remove the transmitter rf head from the transmitter case and use extension cable CMC 457-554 to re-establish connections.

(l) Set the AC POWER switch to the ON/RESET position. The OVERHEAT lamp lights and the buzzer sounds; silence the buzzer.

(m) Set the meter selector switch to the PWR OUT position and observe the unit under test meter. Readjust the PWR OUT PEAK control for peak power as in (h) above.

(n) Locate and remove the access door at the right-hand side of the transmitter rf head dust cover.

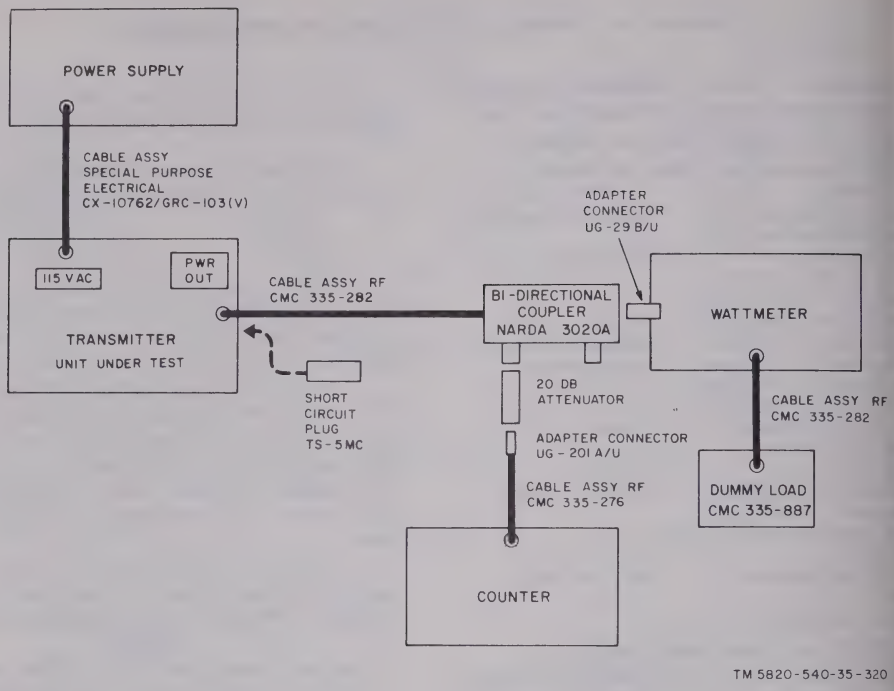


Figure 4-176. Transmitter, operational check, test setup.

(*o*) Locate circuit card assembly 6AR1A2–A2. Use the multimeter to check the heater voltages and the cathode currents as shown below and record the indications.

	Connect multimeter between	Voltage reading (v dc)	Multimeter range
Heater voltage			
Driver amplifier	TP3 and TP4	6.3 ±0.4	10v dc
Output amplifier	TP1 and TP4	6.3 ±0.4	
Cathode current		(Voltage drop between test points)	
Driver amplifier	TP5 and TP6	0.72 ±0.05	2.5v dc
Output amplifier	TP5 and TP7	0.75 ±0.05	

(*p*) On 6AR1A2A2, check to see that the locknuts on potentiometers R1, R2, R3, and R4 are tight.

(*q*) Set the AC POWER switch to OFF and re-install the transmitter rf head in the transmitter case.

(*r*) Set the AC POWER switch to ON.

(*s*) Set the meter selector switch to the PWR OUT position. Record the unit under test meter indication.

(*t*) Set the meter selector switch to the REFL PWR position; the unit under test meter indication should be zero or nearly so.

(*u*) Temporarily disconnect the cable from the unit under test PWR OUT connector; the meter should indicate a level nearly equal to that obtained in (*t*) above.

(2) *Rf output power measurement.*

(*a*) Use the test setup shown in figure 4–176.

(*b*) On the unit under test set the XMTR CHANNEL and XMTR TUNE controls to channel 40.

(*c*) Tune the unit under test to peak power as described in (1)(*g*) and (*h*) above.

(*d*) Check the wattmeter indication; it should be at least **30** watts.

(*e*) Set the voltage control on the power supply (part of the accessory kit) to 105v ac. The wattmeter should indicate at least 30 watts.

(*f*) Set the voltage control on the power supply to 125v ac. The wattmeter should indicate at least 30 watts.

(*g*) Reset the voltage control on the power supply to 115v ac.

(*h*) Repeat (*b*) through (*g*) above for every test channel listed below.

Channel	Frequency (MHz)
40	220.0
85	242.5
130	265.0
179	289.5
180	290.0
225	312.5
270	335.0
315	357.5
360	380.0
400	400.0
409	404.5

CAUTION: The wattmeter should indicate at least 25w for test channel 409.

(*i*) Disconnect the power supply from the 60-Hz supply and connect it to a 400-Hz supply.

(*j*) Repeat (*b*) through (*g*) above for every test channel listed above. The wattmeter should indicate at least 25 watts.

(*k*) Reconnect the power supply to the 60 Hz supply.

(3) *Low-power alarm operating level measurements.*

(*a*) Use the test setup shown in figure 4-176.

(*b*) Tune the unit under test to channel 40 and tune for peak output power as described in (1)(*g*) and (*h*) above.

(*c*) Reduce the output power of the unit under test by slowly detuning the PWR OUT PEAK and or the XMTR TUNE control.

(*d*) Note the power level on the wattmeter at which the LOW POWER alarm lamp lights. It should be between 2.5 w and 6.25w. The buzzer should sound; press the BUZZER OFF pushbutton to silence the buzzer.

(*e*) Slowly restore the output power. Note the power level at which the LOW POWER lamp goes out and the buzzer sounds. Silence the buzzer. The increased power to clear the alarm should not be more than **2.5X** the power measured in (*d*) above.

(*f*) Repeat (*b*) through (*e*) above for all test channels listed in the chart in (2)(*h*) above.

(4) *Output-tube dissipation check.*

(*a*) Use the test setup shown in figure 4-176.

(*b*) Set the voltage control on the power supply to 125v ac.

(*c*) On the unit under test, set the XMTR CHANNEL and XMTR TUNE controls to channel 50 and tune for peak output power as described in (1)(*g*) and (*h*) above. Record the output power as indicated on the wattmeter.

(*d*) Remove the cable from the unit under test PWR OUT connector and leave the unit on for 15 minutes.

(*e*) Connect the shortcircuit plug to the PWR OUT connector and leave the unit on for another 15 minutes.

(*f*) Reconnect the cable to the PWR OUT connector. The wattmeter should indicate as in (*c*) above.

(*g*) On the unit under test set the XMTR CHANNEL control to channel 179 and the XMTR TUNE control to channel 40. (This effectively removes the transmitter drive.)

(*h*) Set the unit under test meter selector switch to MULT. The meter should indicate less than 10 percent of full scale.

(*i*) **Check the output power. The wattmeter should indicate less than 0.5 watt.**

(*j*) Leave the unit under test on for 30 minutes.

(*k*) Set the XMTR CHANNEL and SMTR TUNE controls to channel 50 and tune for peak output power as described in *b*(1)(*g*) and (*h*) above. The wattmeter should indicate as in (*c*) above.

(5) *Transmitter frequency check.*

(*a*) Use the test setup as shown in figure 4-176.

(*b*) Set the voltage control on the power supply for 115v ac.

(*c*) On the unit under test set the XMTR CHANNEL and XMTR TUNE to channel 40 and tune for peak output power as described in *b* (1)(*g*) and (*h*) above. The counter should indicate 200 MHz ±2.2 kHz.

(*d*) Repeat (*c*) above for all test channels listed in *b* (2) (*h*) above. The frequency accuracy shall be within 0.001% of nominal frequency (10 Hz per MHz).

(6) *Frequency deviation measurements.*

(*a*) *Initial setup.* Connect the test equipment as shown in fig. 4-177.

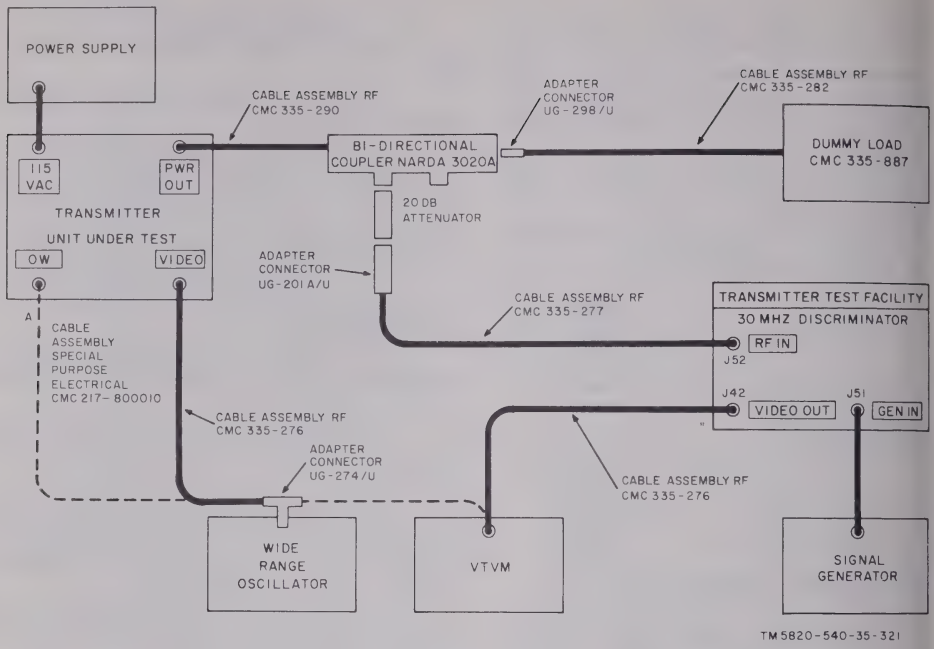


Figure 4-177. Transmitter, frequency deviation measurements, test setup.

(*b*) *24-channel deviation measurement.*

1. Set transmitter test facility switch S1 to ON and switch S20 to 30 MHz DISCR.

2. On unit under test, set the meter selector switch to 24 CH PCM and the INPUT control to midpoint.

3. On the unit under test, set the XMTR CHANNEL and XMTR TUNE controls to channel 50 and tune for peak output power as described in (1)(*g*) and (*h*) above.

4. Adjust the wide range oscillator to 10 kHz at an output of 350 mv rms. Adjust the unit under test INPUT control for a meter indication of 50 percent of full scale.

5. Tune the signal generator to 195 MHz; set the signal generator attenuator to 0 dbm.

6. Observe test facility meter M1 and fine tune the signal generator for a peak indication. Adjust the attenuator on the signal generator to maintain M1 indication at 50 percent full scale. Tune the signal generator for a midscale indication on test facility meter M2. The deviation as indicated by the unterminated VTVM should be between 260 and 386mv rms (1 mv rms = 1 kHz peak deviation).

(*c*) *12-channel deviation measurement.* Using the setup given in (*b*) above, set the unit under test meter switch to 12 CH PCM and adjust the INPUT control for a 50 percent of full scale indication. The deviation as indicated by the unterminated VTVM should be between 156 and 232 mv rms.

(*d*) Order wire deviation measurement.

1. Connect the wide range oscillator to the unit under test OW connector as shown in figure 4-177A.

2. Disconnect the VTVM from test facility connector J42 and connect it to the wide range oscillator.

3. Adjust the wide range oscillator output for a –10 dbm indication on the VTVM.

4. Reconnect the VTVM to test facility connector J42. The VTVM should indicate between 39 and 58 mv rms (1 mv rms = 1 kHz peak deviation).

(*e*) *Checks at other channels.* Repeat (*b*) through (*d*) above for the test channels listed in the chart below.

Channel	Signal generator frequency (MHz)
170	255.0
290	315.0
400	370.0

7) *Frequency response measurements and spurious outputs in video band.*

(*a*) Initial calibration.

1. Connect the test equipment as shown in figure 4–178.

2. Set the unit under test XMTR CHANNEL and XMTR TUNE controls to channel 0 and tune for peak output power as described in *b*(1)(*g*) and (*h*) above.

3. Set the coaxial switch to position 1.

4. Tune the signal generator to 200 MHz at an output of 0 dbm.

5. Set transmitter test facility switch S1 to ON and switch S20 to 30 MHz DISCR.

6. Observe test facility meter M1 and tune the signal generator for a peak indication. Adjust the signal generator attenuator to maintain meter M1 at 50 percent of full scale, then tune until a 50 percent of full scale indication is obtained on test facility meter M2. (Both meters M1 and M2 should indicate 50 percent of full scale.)

7. Set the unit under test meter selector switch to FDM.

8. Tune the wide range oscillator to 0 Hz with an output level of 350 mv rms. Adjust the unit under test INPUT control for 65 percent of full scale indication on the unit under test meter (approximately 100 kHz peak deviation).

9. Check the output signal-to-noise ratio as described below. The output signal-to-noise ratio should be at least 20 db at 960 kHz.

(a) Tune the wide range oscillator to 60 kHz.

(b) Set the frequency of level meter to 960 kHz. Record the level meter indication.

(c) Disconnect the wide range oscillator and increase the level meter gain by 20 db. Record the level meter indication; it should not exceed the reading obtained in (*b*) above (with modulating signal on).

(*b*) *Frequency response tests.*

1. Use the test setup as shown in figure 4–178A.

2. Tune the wide range oscillator to 10 kHz.

3. Set the frequency of the level meter to 10 kHz. Record the level meter indication.

4. Set the coaxial switch to position 2.

5. Adjust the variable attenuators to obtain a level meter indication within ± 0.1 db of the one obtained in *3.* above. Record the variable attenuator settings. This is the reference level.

6. Repeat *2* through *5* above for all frequencies above 10 kHz listed in the chart below and record the attenuation with respect to the reference level (*5* above).

Wide range oscillator (kHz)	Relative attenuation (db), reference 10 kHz		
	Nominal	Minimum	Maximum
0.125	1.0	0.5	1.5
0.200	0.5	0	1.0
0.250	0.2	0	0.4
1.0	0	0.1	0.1
10	0	-	-
30	0	0.2	0.2
60	0.1	0	0.3
120	0.15	0	0.5
240	0.7	0.5	1.3
360	1.3	1.1	2.3
480	2.7	2.4	4.4
600	4.2	3.9	6.9
720	6.0	5.8	9.8
840	8.2	8.0	13.0
960	10.7	9.0	15.0

7. Replace the level meter with the distortion analyzer (fig. 4–178B) and increase the output level of the wide range oscillator by 10 db. Repeat *2* through *5* above for all frequencies below 10 kHz listed in the chart above.

8. Repeat *2* through *7* above for all test channels listed in the chart below.

Channel	Signal generator (MHz)
179	259.5
180	260.0
390	365.0

(*c*) *Spurious outputs in video band test.*

1. Use the test setup shown in figure 4–178A.

2. Set the unit under test XMTR CHANNEL and XMTR TUNE controls to channel 100 and tune for peak output power as described in (1)(*g*) and (*h*) above.

3. Set the coaxial switch to position 1.

4. Tune the wide range oscillator to 10 kHz.

5. Set the frequency of the level meter to 10 kHz.

6. On the unit under test, set the meter selector switch to the 12 CHAN PCM position and adjust the INPUT control for a 50 percent of full scale indication on the unit under test meter.

7. Measure the output signal with the level meter and record this value. This is the reference level.

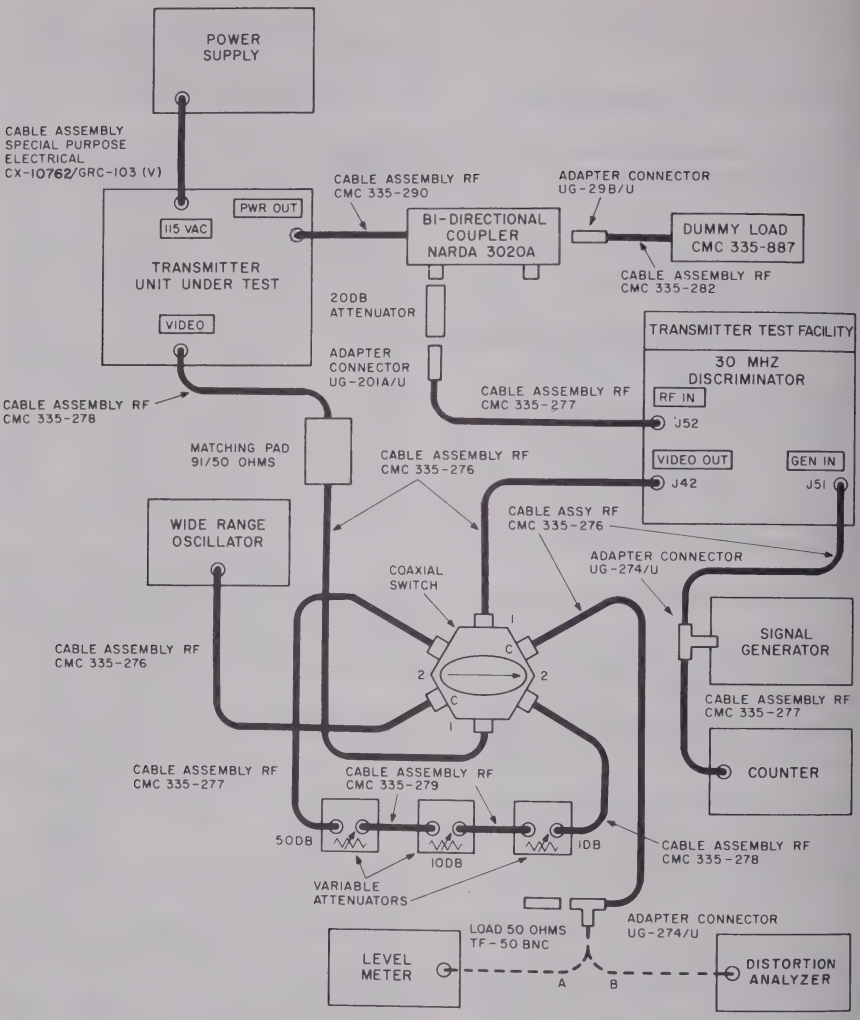


Figure 4-178. Transmitter, frequency response and spurious interference check, test setup.

8. Disconnect the wide range oscillator and search for spurious signals with the level meter from 10 kHz up to 1 MHz. Note the frequency and amplitude of the spurious outputs. They should be at least 60 db below the reference.

9. Replace the level meter with the distortion analyzer to check for frequencies below 10 kHz (fig. 4–178B).

10. Set up the reference level using a 10-kHz signal as described in *3* through *6* above.

11. Disconnect the wide range oscillator and search for spurious signals with the distortion analyzer from 200 Hz up to 10 kHz. Note the frequency and amplitude of the spurious outputs. They should all be at least 50 db below reference.

12. Repeat *2* through *11* above at the channels 60, 179, 180, and 390.

(8) *Power consumption check.*

(*a*) Set the voltage control on the power supply (part of the accessory kit) to 115 v.c.

b) Tune the unit under test to any ann as described in (1)(*g*) and (*h*) above d r te the indication on the power supply ammeter. Indication should be 3.2 amp ± 10 percent.

c. Troubleshooting (fig. 6–14).

Symptom	Probable cause	Checks and corrective measures
Wit AC POWER switch set to C/RESET, the centrifugal f does not start, AC WER and LOW POWER lamps d not illuminate; buzzer does rt sound.	Primary power is absent	Check 115v power source and power cable connections.
	Defective cable W7 or W8	Check cable W7 or W8.
	Loose connections or damaged connectors on distribution box 5A2A1.	*a.* Remove the transmitter fixed head. Refer to paragraph 4-15 for radio transmitter troubleshooting. Repair as required. *b.* Check transmitter case wiring (para 4-27).
Wit AC POWER switch set to N/RESET, the centrifugal n does not start. AC WER and LOW POWER lights e on and the buzzer sounds.	Defective connection or wiring to centrifugal fan 5A2A1.	Check transmitter case wiring (para 4-27).
	Defective centrifugal fan 5A2A1	Check centrifugal fan; replace if necessary.
	Defective power supply 5TR1PS1 (400 Hz inverter) (fig. 3-1).	Refer to paragraph 4-15 for radio transmitter troubleshooting. Repair or replace if necessary.

74 Receiver Radio R–1329(P)/GRC–103(V) and Amplifier-Converter AM–4316/GRC–103(V) Tests and Alignment

a. Test Equipment and Material Required.

Equipment	Common Name
Tes Facility eceiver S-2867(V)1/ RM-95(V)	Receiver test facility
Ac ssory Kit, est Facilities Set K-1173(V)1/ RM-95(V)	Accessory kit
Vo meter Electronic IE-30A/U	VTVM
Ge erator, Signal N/USM-205	Wide range oscillator
G erator, Signal N/USM-44A	Signal generator
Se ctive Voltmeter N/USM-306	Level meter
C nter, Electronic, Digital Readout N/USM-207	Counter
V tmeter, Digital N/GSM-64	Digital voltmeter
G erator Thermal Noise SG-419/U	Noise generator
In icator, Distortion TS-1344/U	Distortion analyzer
Co le Assembly, Special Purpose, Electrical CMC 217-800009	

b. Test Procedures.

(1) *Preliminary operational checks.*

(*a*) Connect the test equipment as shown in figure 4–179A.

(*b*) Set the voltage control on the power supply (part of the accessory kit) to 115 v ac ± 2 percent.

(*c*) Set the unit under test AC POWER switch to ON. Observe the following:

1. The AC POWER lamp should light.

2. The LOW SIGNAL alarm lamp should light.

3. If the SYNC alarm lamp lights, it should go out again within 10 seconds.

4. The buzzer may sound; press the BUZZER OFF button to silence the buzzer.

(*d*) On the unit under test, set the meter selector switch to the following positions and observe the meter indications:

Switch position	Typical indication
+12V	Within the green band
−12V	Within the green band
OSC	20% to 90% of full scale
DOUBLER	20% to 90% of full scale
MULT	0 to 10% of full scale (off tune)
RCVR SIG	Less than 40% of full scale

(*e*) Set the unit under test controls as follows:

Control	Position
RCVR CHANNEL	Channel 200
RCVR SIG	Channel 200
XMTR DUPL	At least 50 channels away from RCVR SIG channel
Meter selector switch	MULT

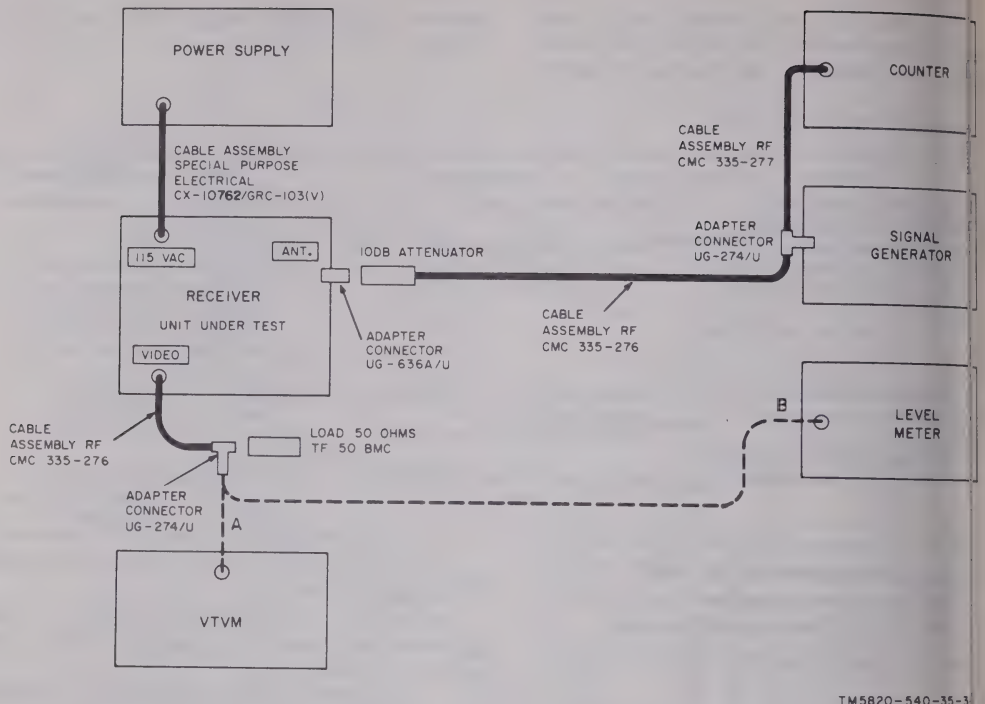


Figure 4-179. Receiver, received signal adjustment and spurious interference checks, test setup.

(*f*) Tune the MULT PEAK control for maximum indication on the meter. The VTVM should indicate approximately –9 dbm.

(*g*) Set the meter selector switch to RCVR SIG; the meter should indicate less than 40 percent of full scale.

(*h*) Set the signal generator to 300 MHz at an output of –64 dbm. The LOW SIGNAL alarm lamp should go out and the buzzer should sound. Silence the buzzer.

(*i*) Adjust the unit under test RCVR SIG control for a **minimum** indication on the meter. (Tune the RCVR SIG control for a ten percent drop on either side of the maximum, then set the RCVR SIG control midway between these two points.)

(*j*) Observe the VTVM indication; it should be approximately –46 dbm or less.

NOTE

The minimum VTVM indication and maximum RCVR SIG meter indication should occur simultaneously (at the same RCVR SIG setting).

(*k*) Set the AC POWER switch to OFF.

(*l*) Remove radio receiver 1RE1 from the receiver case and use extension cables CMC 457–573 and CMC 457–574 to restore connections. Set the AC POWER switch to ON and check the meter indications.

Meter selector switch position	Typical indication
+12V	Within the green ban
-12V	Within the green ban
OSC	20% to 90% of full sc
DOUBLER	20% to 90% of full sc
MULT	20% to 90% of full sc
RCVR SIG	Above 40% of full sc

(2) *Received signal monitoring.*

NOTE

This adjustment is a continuation of the preliminary operational checks above.

(*a*) Adjust the signal generator output to –40 dbm. This corresponds to a –50 dbm output at the ANT. connector of the unit under test.

(*b*) Locate the RCVR SIG ADJUSTMENT control (on the right-hand side of the extended radio receiver 1RE1) and set it fully clockwise.

(c) Locate the METER RCVR SIG con- of he video amplifier 1RE1AR1 (fig. 3-32) l adjust it for a 90 percent of full scale indi- ion on the meter (meter selector switch in RCVR SIG position).

(d) Reduce the level of the signal gener- r output to -115 dbm. RCVR SIG meter indi- ion should be below 40%. The LOW SIG- L alarm lamp should light and the buzzer uld sound. Silence the buzzer.

(e) Increase the output level of the signal era or to -80 dbm. The RCVR SIG meter in- ati should increase by more than 10 cer. The LOW SIGNAL alarm should go out th buzzer should sound. Silence the buzzer.

(f) If these conditions are not met pro- d a follows:

1. Adjust the signal generator output l t -40 dbm.

2. Turn the RCVR SIG ADJUSTMENT nt clockwise until the meter indicates 50 per- t f full scale.

3. Readjust the METER RCVR SIG tr on video amplifier 1RE1AR1 for 90 per- t o full scale indication on the meter.

4. Repeat the tests described in (d) and a ove. If necessary, repeat the adjustment ce ure above.

(g) Repeat the receive signal monitoring ck ((a) through (e) above) for the channels wi below. Tune for maximum RCVR SIG in- ati ns with signal generator output level at d m.

Te t chnel	RCVR CHANNEL and RCVR SIG setting	XMTR DUPL setting	Signal generator frequency (MHz)
0	40	400	220
10	100	400	250
30	300	400	350
40	400	300	400

3) *Frequency deviation measurement.*

(a) Connect the test equipment as shown fi ure 4-180A.

(b) Set the signal generator frequency to Hz as indicated on the counter.

(c) Set the unit under test controls as s:

Control	Position
CR CHANNEL	Channel 50
CR SIG	Channel 50
MR DUPL	At least 50 channels away from the RCVR SIG channel
AC POWER	ON
MULT PEAK	Tune for maximum meter indication

(d) Set the test facility switches as follows:

Switch	Position
S1	ON
S9	30 MHz LEVEL
S14	30 MHz
AT1	0 DB

(e) Adjust the signal generator output level to obtain a 5.0 mv indication on the VTVM.

(f) Set the facility switch S9 to 300 KHZ DEVIATION.

(g) Set the unit under test meter selector switch to 24 CH PCM; the meter should indicate within the green band. The VTVM should indicate 0.265v ± 0.03v rms.

(h) Set test facility switch S9 to 180 KHZ DEVIATION.

(i) Set the unit under test meter selector switch to 12 CH PCM; the meter should indicate within the green band. The VTVM should indicate 0.159v ± 0.018v rms.

(j) On the unit under test, remove the 91 ohm load from the PCM output connector. The meter indication should drop to zero.

(k) On the unit under test replace the 91 ohm load at the PCM output connector. The meter should indicate within the green band.

(l) Connect the test equipment as shown in figure 4-180B.

(m) Set the test facility switch S9 to 75 KHZ DEVIATION.

(n) Set the unit under test meter selector switch to FDM; the meter should indicate within the green band. The VTVM should indicate 0.189v ± 0.021v rms.

(o) Connect the test equipment as shown in figure 4-180C.

(p) Set the test facility switch S9 to 45 KHZ DEVIATION.

(q) Set the unit under test meter selector switch to OW; the meter should indicate within the green band. The VTVM should indicate 0.245v ± 0.045v rms.

(4) *Video gain stability measurement.*

(a) Initial calibration procedure.

1. Connect the test equipment as shown in figure 4-179B.

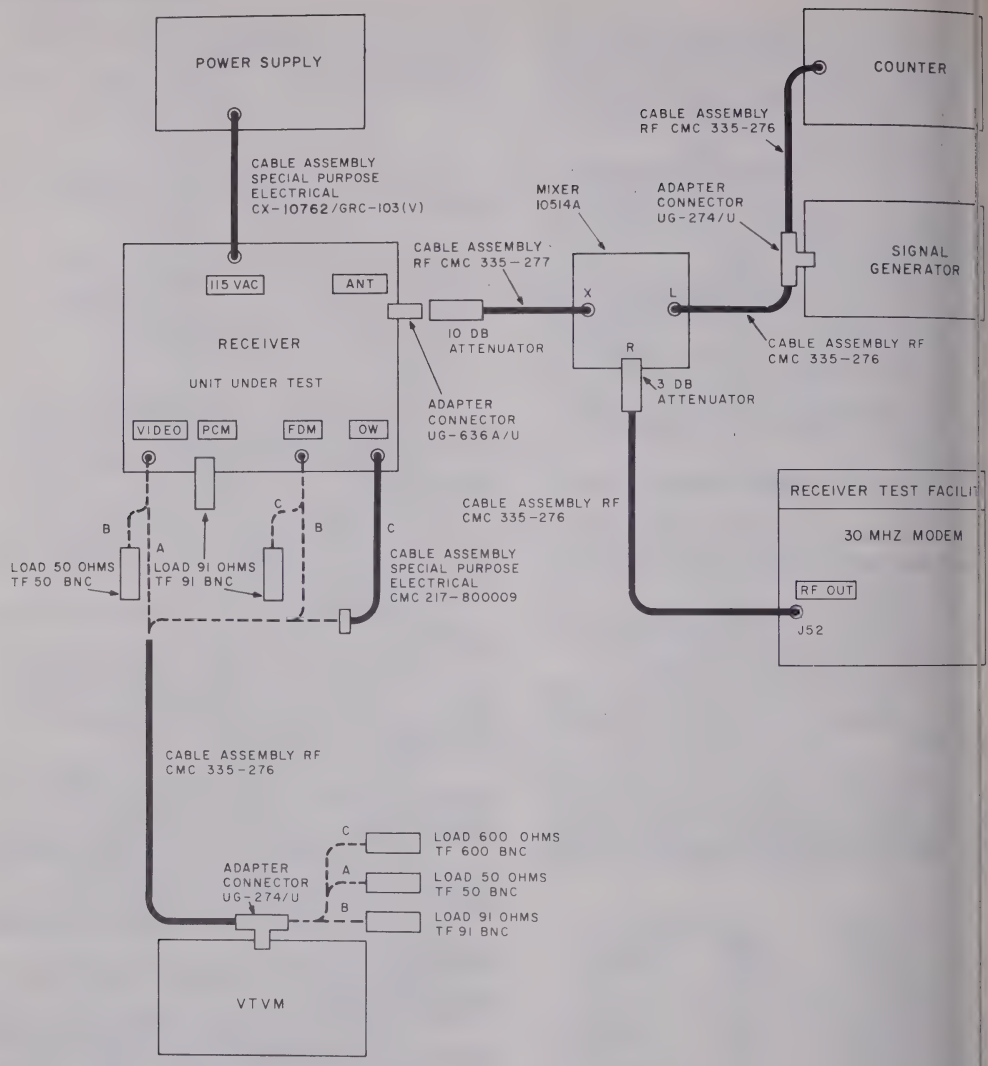


Figure 4-180. Receiver frequency deviation measurement, test setup.

2. Set the signal generator frequency to 290 MHz at a level of –85 dbm. (This corresponds to a –95 dbm signal at the ANT. connector.)

Control	Position
RCVR CHANNEL	Channel 180
RCVR SIG	Channel 180
XMTR DUPL	At least 100 channels away from the RCVR SIG setting
AC POWER	ON
MULT PEAK	Tune for maximum meter indication

3. Set the unit under test contr s a follows:

4. On the unit under test set the ete selector switch to RCVR SIG and adjust th fre quency of the signal generator for a max num indication on the unit under test meter.

5. Set the level meter frequency 40 kHz at 2.0 kHz bandwidth. Record the eve meter indication.

6. Repeat *1* through *5* above for gna generator output levels of –74 dbm, –54 bm

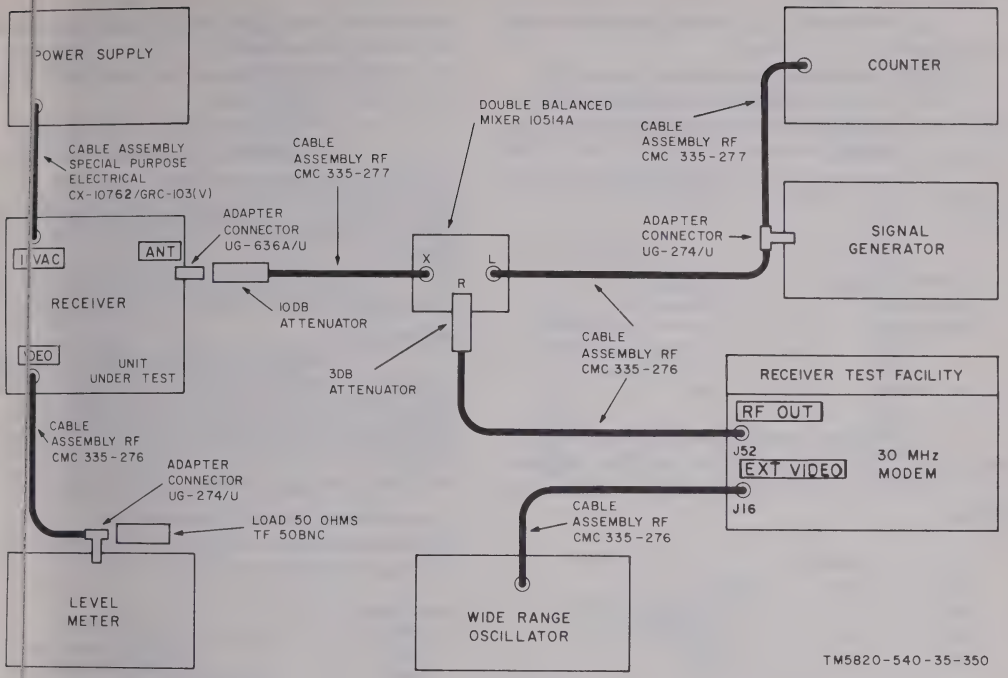


Figure 4-181. Receiver video gain stability check, test setup.

-4 dbm. (–84 dbm, –64 dbm, and –54 dbm at the ANT. connector).

7. Connect the test equipment as shown figure 4–181.

8. Set the signal generator frequency MHz ±30 kHz as shown on the counter.

9. Set test facility switches S1 to ON to 30 MHZ LEVEL.

10. Adjust the signal generator output to obtain an identical level meter indica- s in *5* above. Record the signal generator ator setting.

11. Repeat *10* above to obtain identical meter indications as in *6* above for each generator level used. Record each of the generator attenuator settings.

(*b*) *Video gain stability vs output level.*

1. Use the test setup shown in figure

2. Return the signal generator attenua- ting to that recorded in (*a*) *10* above.

3. Set the test facility switches as s:

Switch	Position
9	EXT. VIDEO
14	30 MHz
T1	0 DB

4. Set the level meter to 10 kHz.

5. Set the wide range oscillator to 10 kHz and adjust the output level for a –5 dbm indication on the level meter.

6. Return the signal generator attenuator to each of the settings recorded in (*a*) *11* above. The level meter indication should remain within –5 dbm ± 0.5 db for each of the above attenuator settings.

7. Return the signal generator attenuator to the setting recorded in (*a*) *10* above. The level meter indication should return to –5 dbm.

(*c*) *Video gain stability vs supply voltage variation.*

1. With the equipment set as in (*b*) *7* above, vary the voltage control on the power supply (part of the accessory kit) between 105 volts and 125 volts ac. The level meter indication should remain within –5 dbm ± 0.5 db.

2. Set the voltage control on the power supply to 115 volts ac.

3. Disconnect the power supply from the 60-Hz source and connect it to a 400-Hz source. The level meter indication should remain within –5 dbm ± 0.5 db.

4. Reconnect the power supply to the 60-Hz source.

(5) *Video frequency response.*

(*a*) *Initial calibration porcedure.*

1. Connect the test equipment as shown in figure 4–182A.

2. Set the unit under test controls as follows:

Control	Position
RCVR CHANNEL	Channel 40
RCVR SIG	Channel 40
XMTR DUPL	At least 30 channels away from RCVR SIG channel
AC POWER	ON

3. Set the signal generator frequency to 190 MHz ± 30 kHz as shown on the counter.

4. Set the test facility switches as follows:

Switch	Position
S1	ON
S9	30 MHz LEVEL
S14	30 MHz
AT1	0 DB

5. Adjust the signal generator attenuator for a 5-mv indication on the VTVM.

6. Set the unit under test meter selector switch to RCVR SIG and tune the RCVR SIG control for a maximum meter indication.

7. Connect the test equipment as shown in figure 4–182B.

8. Set the coaxial switch to position 2.

9. Set test facility switch S9 to 75 KHz DEVIATION.

10. Set the unit under test meter selector switch to FDM; the meter should indicate within the green band.

11. Set test facility switch S9 to EXT VIDEO.

12. Check the signal-to-noise ratio as described below:

(a) Set the wide range oscillator to 960 kHz and adjust the output level until the unit under test meter indicates within the green band as in *10* above.

(b) Set the level meter to 960 kHz with 2.0 kHz bandwidth and record the level meter indication.

(c) Disconnect the wide range oscillator from the coaxial switch and record the level meter indication. The difference between this reading and the one recorded in (b) above be greater than 20 db.

(d) Reconnect the wide range tor to the coaxial switch.

(*b*) *Frequency response measurem*

1. With the coaxial switch in pos set the wide range oscillator to 10 kHz a just the output level until the unit und meter indicates within the green band above).

2. Set the level meter to 10 k the bandwidth to 2.0 kHz. Record the leve indication.

3. Set the coaxial switch to pos Adjust the variable attenuators for the sam meter indication as in *2* above ± 0.1 db. the variable attenuator settings; this is th ence level.

4. Repeat *1* through *3* above f frequencies listed in the chart below and the attenuation in respect to the referen obtained in *e* above.

Wide range oscillator and level meter frequency (kHz)	Relative attenuation (db) reference 10 kHz	
	Nominal	Minimum
30	0	-0.1
60	0.15	0.05
120	0.6	0.2
180	1.3	0.8
240	2.3	1.8
360	5.1	4.4
480	9.0	8.2
600	14.0	12.5
720	20.2	18.4
840	27.5	25.3
960	36.0	33.0

NOTE

Check to see that the attenuation at kHz d not change by more than ±1db when the XM DUPL control is tuned across its range, exc within ±30 channels of the RCVR CHANN setting.

(6) *Noise figure measurement.*

(*a*) Connect the test equipment as in figure 4–183.

(*b*) Set noise generator switch 10–2 and its output level control to OFF.

(*c*) Set the signal generator frequ 220 MHz and its output level to –54 dbm corresponds to –74 dbm at the ANT. conn

(*d*) Set the unit under test contr follows:

Control	Position
RCVR CHANNEL	Channel 40
RCVR SIG	Channel 40
XMTR DUPL	At least 30 channels away from RCVR SIG setting
AC POWER	ON
Meter selector switch	MULT

(*e*) Tune the MULT PEAK control for maximum meter indication. Set the meter selector switch to RCVR SIG and tune the RCVR control for a maximum meter reading. The level as indicated on the VTVM should be 46 dbm or less.

(*f*) Insert a 3-db attenuator between the connector and the VTVM.

(*g*) Adjust the output level control on noise generator to obtain the same VTVM indication as in (*e*) above. Read the noise figure on the noise generator meter; it should not exceed 8.75 db. Return the output level control to OFF after each reading.

NOTE

Allow sufficient time for indications to stabilize before reading noise figure.

(*h*) Repeat (*c*) through (*g*) above for all test channels listed in the chart below:

RCVR SIG and RCVR CHANNEL setting	Signal generator frequency (MHz)
040	220
090	245
119	259.5
120	260
160	280
200	300
240	320
280	340
320	360
360	380
400	400
409	404.5

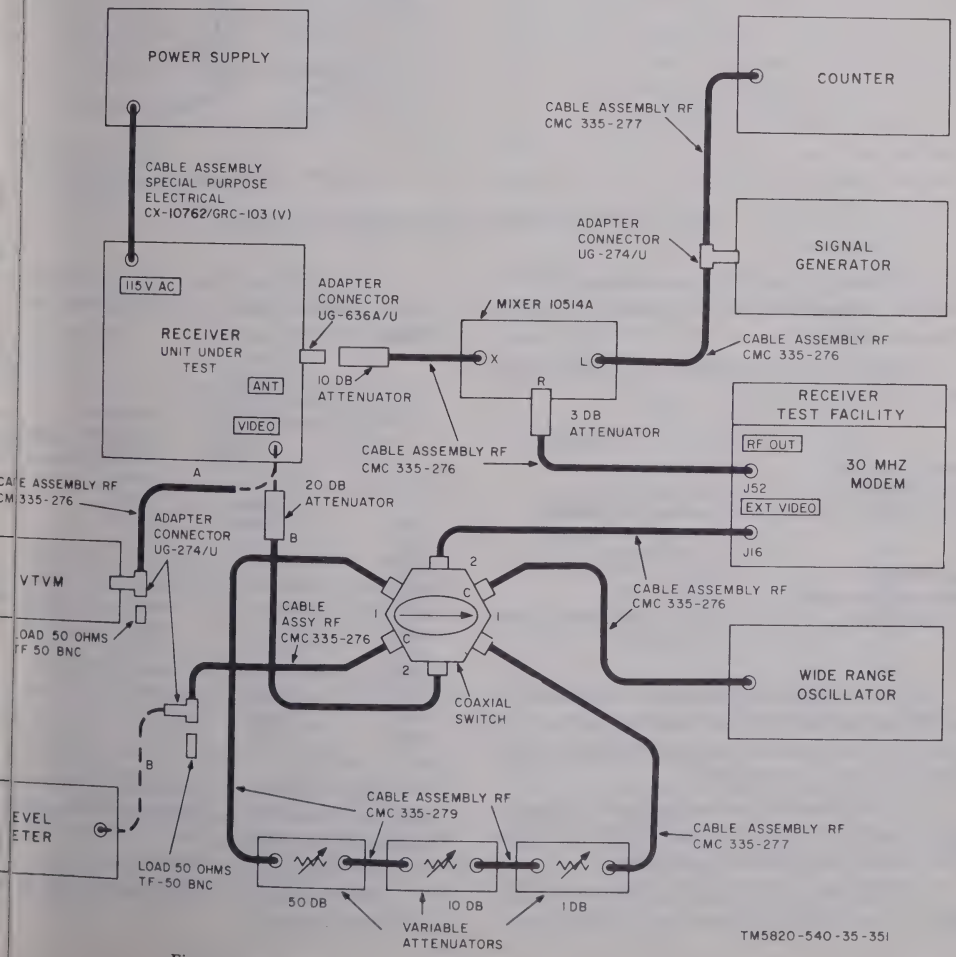


Figure 4-182. Receiver video frequency response check, test setup.

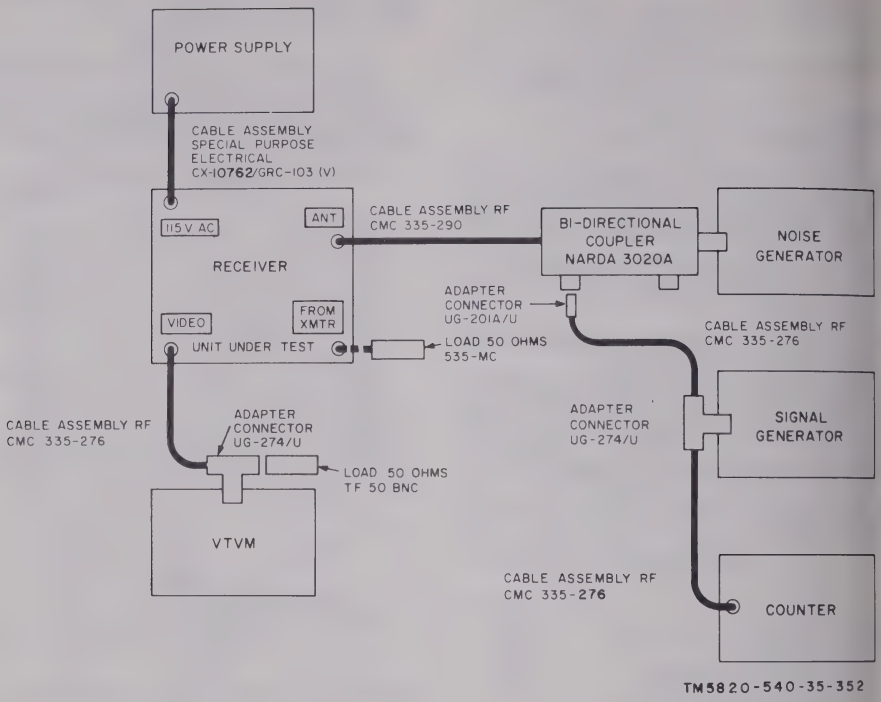


Figure 4-183. Receiver noise figure measurement, test setup.

(7) *Narrow band noise measurements.*

(*a*) Connect the test equipment as shown in figure 4–179B.

(*b*) Set the unit under test controls as follows:

Control	Position
RCVR CHANNEL	Channel 50
RCVR SIG	Channel 50
XMTR DUPL	At least 30 channels away from RCVR SIG setting
AC POWER	ON
Meter selector switch	MULT
MULT PEAK	Tune for maximum meter indication

(*c*) Set the signal generator frequency to 225 MHz as indicated on the counter, at an output level of –64 dbm (this corresponds to –74 dbm at the ANT. connector).

(*d*) Set the unit under test meter selector switch to RCVR SIG and adjust RCVR SIG control for maximum meter indication.

(*e*) Set the level meter to 2.0 kHz bandwidth.

(*f*) Set the level meter to the frequencies listed in table below and record the level meter indications.

Level meter setting (kHz)	Noise power in 4 kHz band (dbm),50 ohms for 8.8 db noise figure	Reading on level meter (dbm)	Tolerance on indication (*b*)
10	-67 max.	-71 max.	
20	-67 max.	-71 max.	
30	-67 max.	-71 max.	
60	-64.8	-68.6	0.5
120	-59.3	-63.1	0.5
180	-56.5	-60.3	0.5
240	-55.0	-58.8	0.5
360	-54.3	-58.1	0.5
480	-55.7	-59.5	0.8
600	-58.7	-62.5	1.2
720	-63.4	-67.2	1.8
840	-69.3	-73.1	2.2
960	-76.7	-80.5	3.0

(*g*) Repeat (*b*) through (*f*) at channel 180 and 400 (signal generator frequency 29 MHz and 400 MHz).

(8) *Spurious baseband signal tests.*

(*a*) Connect the test equipment as shown in figure 4–179B.

(*b*) Set the unit under test controls as low

Control	Position
RCV CHANNEL	Channel 50
RCV SIG	Channel 50
XMT DUPL	At least 30 channels away from the RCVR SIG setting
AC POWER	ON
Meter selector switch	MULT
MUL PEAK	Tune for maximum meter indication

(*c*) Set the signal generator frequency to 5 MHz at a level of –44 dbm (this corresponds –5 dbm at the ANT. connector).

(*d*) Set the unit under test meter selector itc to RCVR SIG and adjust RCVR SIG con- l fr maximum meter indication.

(*e*) Set the level meter to 2.0 kHz band- dth and search the baseband from 10 kHz to MHz for spurious signals. The level of any uri- us signals at any frequency should be be- –5 dbm.

() *LOW SIGNAL and HIGH SIGNAL rm measurements.*

(*a*) Connect the test equipment as shown fi re 4–179A.

(*b*) Set the unit under test controls as lo s:

Control	Position
RCR CHANNEL	Channel 50
RCR SIG	Channel 50
XMR DUPL	At least 30 channels away from the RCVR SIG setting
AC OWER	ON
Me r selector switch	MULT
MU T PEAK	Tune for maximum meter indication

(*c*) Set the signal generator output el to –74 dbm (this corresponds to –84 dbm th ANT. connector). The VTVM should indi- e 36 dbm or less.

(*d*) Set the unit under test meter selector to RCVR SIG and tune the RCVR SIG t l for maximum meter indication.

(*e*) Reduce the signal generator output e until the LOW SIGNAL alarm lamp lights d the buzzer sounds; silence the buzzer. e signal generator output level should be –88 n ± 3 db (corresponding to –98 dbm ± 3 db t ANT. connector). The VTVM should indi- e –23 dbm ± 2 db.

(*f*) Increase the output level of the signal generator until the LOW SIGNAL alarm lamp goes out and the buzzer sounds; silence the buzzer. The signal generator output level should be –86 dbm ± 3 db. The VTVM should indicate –25 dbm ±2 db.

(*g*) Repeat (*b*) through (*f*) above at channels 180 and 400 (signal generator frequencies 290 MHz and 400 MHz).

(*h*) Remove the 10-db attenuator from the ANT. connector and connect the signal generator directly to the ANT. connector.

(*i*) Set up the equipment as described in (*b*) above.

(*j*) Set the signal generator output level to –70 dbm.

(*k*) Set the unit under test meter selector switch to RCVR SIG and adjust the RCVR SIG control for a maximum meter indication.

(*l*) Increase the signal generator output level until the HIGH SIGNAL alarm lamp lights and the buzzer sounds; silence the buzzer. This should occur for a signal generator output level between –15 dbm and +5 dbm. Record the level.

(*m*) Reduce the signal generator output until the HIGH SIGNAL alarm lamp goes out and the buzzer sounds; silence the buzzer. The signal generator output level should be within 2 db above the level obtained in (*l*) above.

(*n*) Repeat (*j*) through (*m*) above for the test channels listed below.

RCVR SIG and RCVR CHANNEL setting	Signal generator frequency (MHz)
40	220
100	250
200	300
300	350
400	400

(10) *Power consumption check.*

(*a*) Connect the equipment to the power supply (part of the accessory kit).

(*b*) Set the voltage control on the power supply to 115v ac.

(*c*) Set the unit under test AC POWER switch to ON and note the indication on the power supply ammeter; it should be 0.35 ampere.

4-75. Radio Set System Tests and Alignment

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Transmitter TS-2866(V)1/GRM-95(V)	Transmitter test facility
Test Facility, Receiver TS-2867(V)1/GRM-95(V)	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V)	Accessory kit
Voltmeter, Electronic ME-30A/U	VTVM
Generator, Signal AN/USM-205	Wide Range oscillator
Generator, Signal AN/USM-44A	Signal generator
Selective Voltmeter AN/USM-306	Level meter
Wattmeter AN/URM-120	Wattmeter
Counter, Electronic Digital Readout AN/USM-207	Counter
Cable Assembly, Special Purpose, Electrical, Branched CMC 217-800011 (fig. 5-18)	
Indicator, Distortion TS-1344/U	Distortion analyzer
Oscilloscope AN/USM-281	Oscilloscope

b. Test Procedures.

(1) Transmitter antenna power check.

(a) Connect the test equipment as shown in figure 4-184.

(b) Set the voltage control on the power supply (part of the accessory kit) to 115v ac.

(c) Set the receiver and transmitter AC POWER switches to their ON and ON/RESET position. The ammeter on the power supply should indicate less than 3.5 amperes. Observe the following on the unit under test.

1. AC POWER lamps should light.

2. SYNC alarm lamps may light; they should extinguish within 10 seconds.

3. LOW POWER alarm lamp should light.

4. LOW SIGNAL alarm lamp should light.

5. Buzzers should sound; silence the buzzers.

6. Blower should operate; OVERHEAT lamp should light, but should extinguish within 10 seconds.

(d) On the receiver, set the RCVR CHANNEL and RCVR SIG controls to channel 400 and the XMTR DUPL control to channel 40.

(e) On the transmitter, set the XMTR CHANNEL and XMTR TUNE controls to channel 40. Set the meter selector switch to the following positions in turn and observe the meter indication.

Meter selector switch position	Typical meter indi
12V	within green ba
28V	within green ba
600V	within green ba
OSC	20% to 90% fu
DOUBLER	20% to 90% fu
MULT	20% to 90% fu

[a]May not be 20%-90% until after unit is fully tuned.

(f) Set the transmitter meter selector to DRIVER. Push in the PWR OUT PEAK and tune for maximum meter indication; the should indicate between 20 and 90 percent scale.

(g) Set the transmitter meter selector to PWR OUT. Pull out the PWR OUT control and tune for maximum meter indicati meter should indicate above midscale. The POWER alarm light should go out and the should sound; silence the buzzer.

(h) Set the transmitter meter selector to REFL PWR and tune the receiver XMTR control for a minimum transmitter meter indi the meter should indicate less than 15 percent scale. Record the REFL PWR indication.

(i) Set the receiver meter selector swih XMTR DUPL. On the transmitter readju PWR OUT PEAK (control in pulled-out positi a maximum indication on the receiver mete meter should indicate above midscale. Reco PWR OUT indication on the transmitter me r.

(j) Set the receiver meter selector swih REFL PWR. The receiver meter should indica than 15 percent of full scale. Record the POWER indication.

(k) Set the receiver meter selector swi XMTR DUPL position and tune the XMTR control for maximum meter indication. Reco XMTR DUPL indication. The wattmeter s indicate at least 18 watts.

(l) Repeat the antenna power measure ((d) through (k) above) for all the remaining ch listed in the chart below.

NOTE

Omit the 12V, 28V and 600V meter i dications (e) above).

Set the AC POWER switch on the tran mitter to OFF when changing from receiv channel 400 to 50.

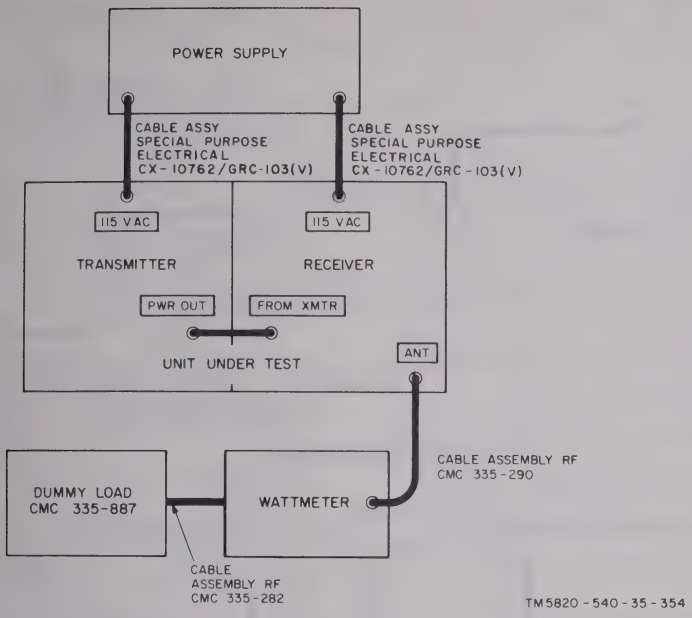


Figure 4-184. Radio set, output power to antenna, test setup.

XMTR CHANNEL XMTR DUPL and XMTR TUNE channel settings	RCVR CHANNEL and RCVR SIG channel settings
40	400
70	400
100	400
140	400
179	400
180	400
220	50
260	50
300	50
340	50
380	50
409	50

(*m*) Set the AC POWER switch on the itter to OFF.

System gain and frequency response-

(*a*) *Initial calibration.*

1. Connect the test equipment as shown e 4–185A.

2. Set the signal generator frequency MHz as indicated on the counter and set put level to –94 dbm.

3. Set the coaxial switch to position 1.

4. Set the receiver controls as follows:

Control	Setting
RCVR CHANNEL	Channel 240
RCVR SIG	Channel 240
XMTR DUPL	At least 30 channels away from RCVR SIG setting
AC POWER	ON
Meter selector switch	MULT PEAK
MULT PEAK	Tune for maximum meter indication
Meter selector switch	RCVR SIG
RCVR SIG	Tune for maximum meter indication.

5. Set the level meter to 400 KHz and 2.0 kHz bandwidth. Record the level meter indication.

6. Record the level meter indications for signal generator output levels of –84 dbm, –74 dbm, –64 dbm, and 54 dbm. The level meter indications should decrease in approximately 10 db steps.

NOTE

Agc action may be noticed before reaching the –54 dbm level.

7. Connect the test equipment as shown in figure 4–185B with coaxial switch in position 1.

8. Disconnect the wide range oscillator.

9. Set the AC POWER switch on the transmitter to ON/RESET.

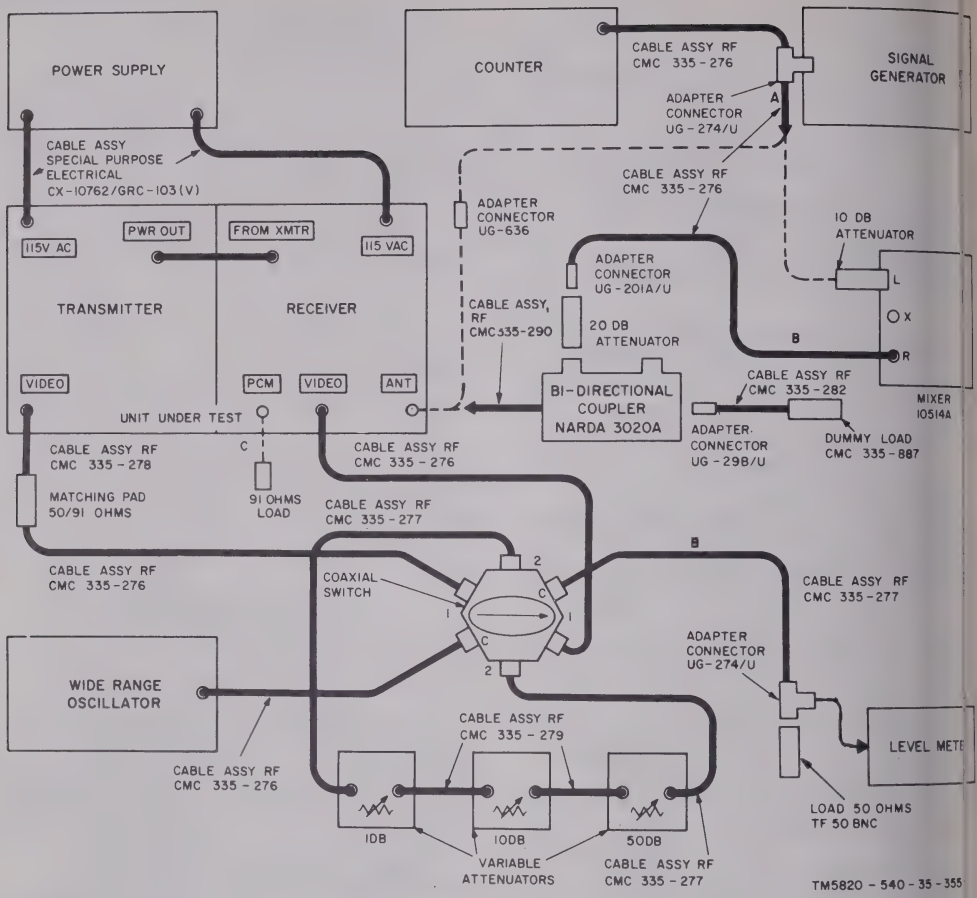


Figure 4-185. Radio set, system gain and frequency response measurements test setup.

10. Set the transmitter to channel 340 and tune for maximum PWR OUT as described in (1)(*f*) through (*k*) above, but it is not necessary to record any of the meter indications called for.

11. Set the signal generator frequency to 50 MHz and adjust the output level until the level meter indication is the same as obtained in *6* above for –74 dbm.

NOTE

Use this signal generator output level throughout the following system gain and frequency response measurement in (*b*) and (*c*) below.

12. Reconnect the wide range oscillator.

(*b*) *System gain measurement.*

1. Connect the test equipment as shown in figure 4–185B.

2. Set the coaxial switch to position 1.

3. Set the transmitter and receiver meter selector switches to their respective 24 CH PCM positions.

4. Set the transmitter INPUT control to midrange.

5. Set the wide range oscillator to 10 kHz and adjust the output level for a 50 percent indication on the transmitter meter. The receiver meter should indicate in the green and

6. Set the level meter to 10 kHz and 2.0 kHz bandwidth. The level meter should indicate –0.3 dbm ± 3 db.

7. Set transmitter and receiver meter selector switches to their 12 CH PCM positio

8. Terminate the PCM connector of the unit under test with a 91–ohm load (fig. 4–185C).

9. Repeat *4* through *6* above. The level meter should indicate –4.8 dbm ± 3 dbm.

c) *Frequency response measurement.*

1. Connect the test equipment as shown e 4–185B.

2. Set the coaxial switch to position 1.

3. Set the transmitter and receiver meter switch to their FDM positions. Set the control to midrange.

4. Set the wide range oscillator to 960 d adjust the output level control for a ent full scale indication on the transmit- er.

5. Set the level meter to 960 kHz and Iz bandwidth. Record the level meter on.

6. Temporarily disconnect the wide oscillator and note the level meter indica- should be at least 22 db below the level d in 5 above.

7. Set the wide range oscillator to 10 d adjust its output level for a 65 percent ion on the transmitter meter. Record the level of the wide range oscillator as indi- n its own meter, and maintain this level nout the remaining steps.

8. Set the level meter to 10 kHz and 2.0 ndwidth. Record the level meter indica-

9. Set the coaxial switch to position 2. the variable attenuators to obtain the same eter indication as in 8 above. Record the e attenuators setting; this is the 10-kHz ce level.

10. Repeat 8 and 9 above for all modu- frequencies listed in the chart below. The e attenuation should be within the limits

g

Relative attenuation (db), reference attenuation 10 kHz		
Nominal	Minimum	Maximum
REF.	REF.	REF.
0	−0.1	+0.1
0.2	0.1	0.3
0.7	0.5	0.9
1.6	1.3	1.9
2.9	2.5	3.3
6.5	5.7	7.3
11.7	10.2	13.2
18.2	16.0	20.4
26.2	23.1	29.3
35.7	31.7	39.7
46.7	41.2	52.2

3) *Signal-to-noise and high signal protec- rcuits check.*

(a) *Deviation calibration procedure.*

1. Connect the test equipment as in 4–186.

2. Set the signal generator frequency to 320 MHz as indicated on the counter and set the output level to –74 dbm.

3. Set the receiver controls as follows:

Control	Setting
RCVR CHANNEL	Channel 240
RCVR SIG	Channel 240
XMTR DUPL	At least 30 channels away from RCVR SIG setting
AC POWER	ON
Meter selector switch	MULT PEAK
MULT PEAK	Tune for maximum meter indication
Meter selector switch	RCVR SIG
RCVR SIG	Tune for maximum meter indication

4. Record the noise level as indicated on the VTVM.

5. Set the signal generator output level to –94 dbm and record the VTVM indication (noise level).

6. Connect the test equipment as shown in figure 4–187.

7. Set the signal generator to 290 MHz as indicated on the counter.

8. Set the test facility switches as follows:

Switch	Position
S1	ON
S9	30 MHz LEVEL
S14	30 MHz
AT1	0 DB

NOTE

Check for maximum RCVR SIG meter indication on the receiver meter.

9. Adjust the signal generator output to obtain the same VTVM indication (noise level) as in 4 above.

10. Set test facility switch S9 to 180 KHz DEVIATION.

11. Set the receiver meter selector switch to 12 CH PCM. The receiver meter should indicate within the green band; record this indication. The VTVM should indicate 159 mv ±18 mv (–13.5 dbm ± 1 db); record this indication.

12. Set test facility switch S9 to 300 KHz DEVIATION.

13. Set the receiver meter selector switch to 24 CH PCM. The receiver meter should indicate within the green band; record this indication. The VTVM should indicate 265 mv ±30 mv; record this indication.

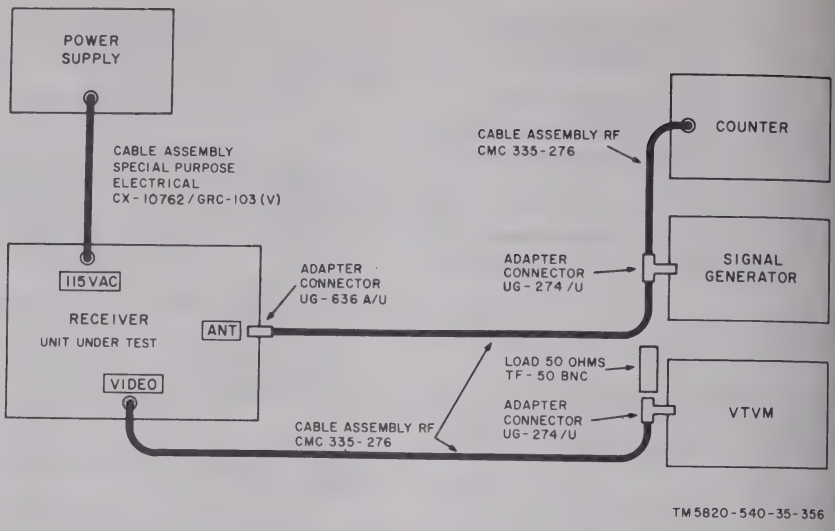


Figure 4-186. Receiver deviation calibration procedure, test setup.

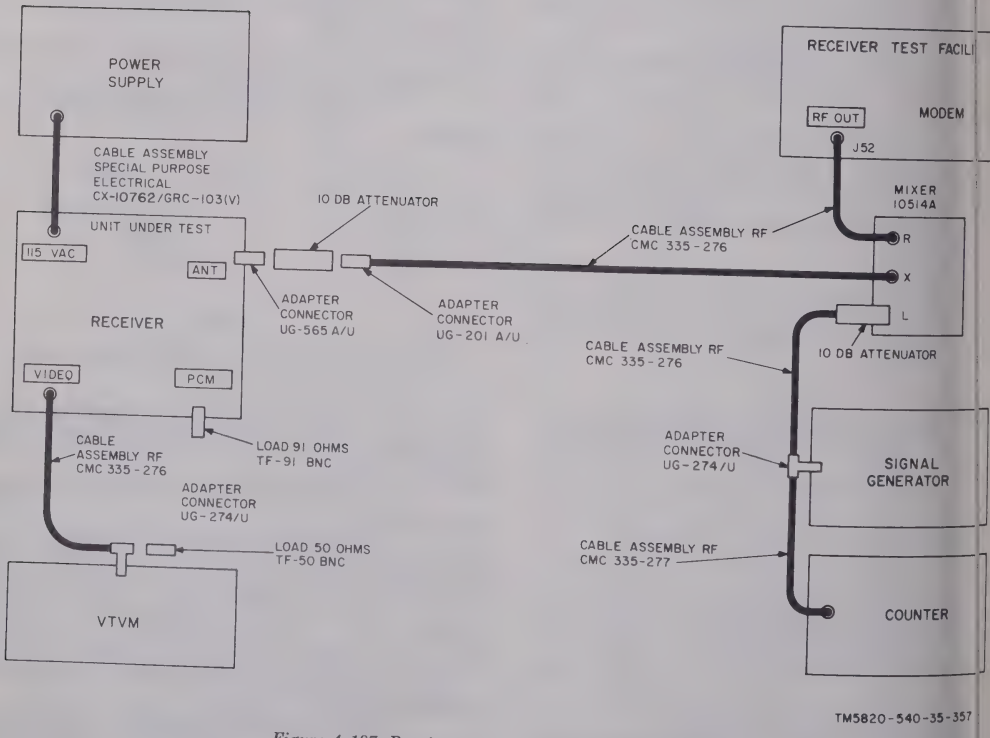


Figure 4-187. Receiver deviation measurement, test setup.

14. Adjust the signal generator output for a VTVM indication (noise level) as obtained in *4* above and repeat *11* through *13*. The VTVM should indicate as in *11* and *13 above.* Repeat this indication.

(*b*) *Signal-to-noise measurement.*

1. Connect the test equipment as shown ure 4–188.

2. Set the signal generator frequency MHz as indicated on the counter.

3. Set the receiver controls as follows:

Controls	Settings
VR CHANNEL	Channel 240
VR SIG	Channel 240
TR DUPL	Channel 340
POWER	ON
ter selector switch	MULT PEAK
ULT PEAK	Tune for maximum meter indication
ter selector switch	RCVR SIG
VR SIG	Tune for maximum meter indication

4. Disconnect the wide range oscillator.

5. Switch on the transmitter, set it to el 340, and tune for maximum PWR OUT minimum REFL PWR indications as described in (1)(*f*) through (*k*) above, but do not record any of the meter indications.

6. Adjust the signal generator output level for a VTVM noise level indication as obtained in (*a*)*4* above.

7. Set the receiver and transmitter meter selector switches to their 12 CH PCM positions. Set the transmitter INPUT control to mid-range.

8. Reconnect the wide range oscillator.

9. Set the wide range oscillator to 10 kHz and adjust its output to obtain a 50 percent indication on the transmitter meter. The receiver meter should indicate as in (*a*)*11* above. The VTVM should indicate 159 mv ± 18 mv. (-13.5 dbm ± 1 db).

10. Disconnect the wide range oscillator and record the noise level on the VTVM. It should be at least 31.25 db below the level obtained in *9* above.

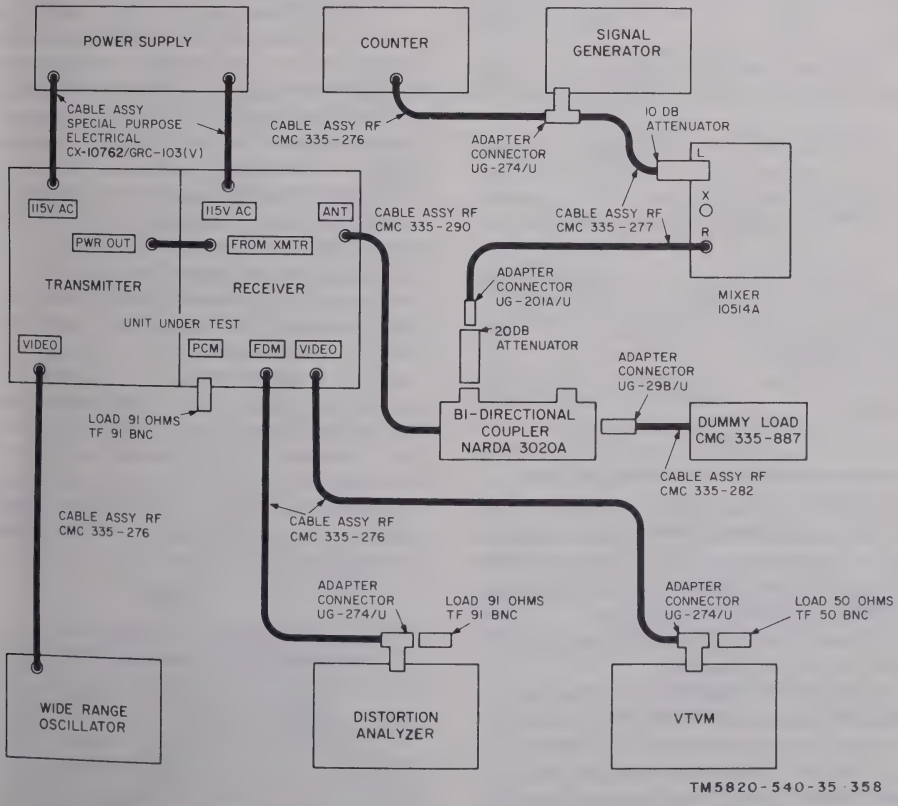


Figure 4-188. Radio set signal-to-noise and harmonic distortion measurement test setup.

11. Adjust the signal generator output level to obtain the same VTVM noise level as in (*a*)*5* above.

12. Reconnect the wide range oscillator. The receiver meter should indicate as in (*a*)*13* above. The VTVM should indicate 159 mv ± 18 mv (–13.5 dbm ± 1 db).

13. Disconnect the wide range oscillator and record the noise level as indicated on the VTVM; it should be at least 11.25 db lower than the level in *12* above.

14. Set the transmitter and receiver meter selector switches to their 24 CH PCM positions.

NOTE

The equipment is set up for a –94-dbm signal level from the previous test.

15. Reconnect the wide range oscillator and adjust the output level to obtain a 50 percent indication on the transmitter meter. The VTVM should indicate 265 mv ± 30 mv.

16. Disconnect the wide range oscillator and record the noise level on the VTVM. It should be at least 15.25 db below the level in *15* above.

17. Adjust the signal generator to obtain the same VTVM indication as recorded in (*a*)*4* above.

18. Reconnect the wide range oscillator and adjust its output level to obtain a 50 percent of full scale indication on the transmitter meter. The VTVM should indicate 265 mv ± 30 mv.

19. Disconnect the wide range oscillator and record the noise level on the VTVM. It should be at least 35.25 db below the level recorded in *18* above.

(*c*) *High signal alarm and receiver protection check.*

NOTE

This is a continuation of the test in (*b*) above.

1. Set the transmitter to channel 240 and tune for a maximum PWR OUT indication as described in (1) (*f*) through (*k*) above. The HIGH SIGNAL alarm lamp should light and the buzzer should sound; silence the buzzer.

2. Leave the equipment in this condition for approximately 30 seconds.

3. Reset the transmitter to channel 340 and tune for a maximum PWR OUT indication as described in (1) (*f*) through (*k*) above.

4. Repeat the signal-to-noise tests in (*b*) above. There should be no degradation in the signal-to-noise ratio results.

(4) *Total harmonic distortion.*

(*a*) Set the AC POWER switch the transmitter to OFF. Connect the test equ ment as shown in figure 4–186.

(*b*) Set the signal generator frequ y to 320 MHz as indicated on the counter a set the output level to –54 dbm.

(*c*) Set the receiver controls as f ows:

Controls	Settings
RCVR CHANNEL	Channel 240
RCVR SIG	Channel 240
XMTR DUPL	Channel 340
AC POWER	ON
Meter selector switch	MULT PEAK
MULT PEAK	Tune for maximu meter indicatio
Meter selector switch	RCVR SIG
RCVR SIG	Tune for maximu meter indicatio

(*d*) Record the noise level as indica d on the VTVM.

(*e*) Connect the test equipment as own in figure 4–188.

(*f*) Disconnect the wide range osc ator.

(*g*) Set the AC POWER switch the transmitter to ON/RESET. Set the trans itter to channel 340 and tune for maximum PWR OUT as described in (1) (*f*) through (*k*) above, t it is not necessary to record any of the mete ndications called for.

(*h*) Set the transmitter and receiver eter selector switches to their 24 CH PCM po ions and the transmitter INPUT control to mid nge.

(*i*) Set the signal generator to 50 M z as indicated on the counter and adjust its tput level for a VTVM noise level indication ob- tained in (*d*) above.

(*j*) Reconnect the wide range osci tor; set the frequency of the wide range oscilla r to 10 kHz and adjust its output level for a 5 per- cent indication on the transmitter meter. R ord the wide range oscillator output level as ind ated on its own meter. The receiver meter should ndi- cate in the green band. The VTVM should ndi- cate 265 mv ± 30 mv.

NOTE

Maintain the above wide range oscillator outp level throughout the following tests.

(*k*) Record the level indicated on th dis- tortion analyzer in the SET LEVEL positio

(*l*) Set the distortion analyzer to DIS R- TION and check the total harmonic disto ion. It should be at least 26 db below the leve ob- tained in the SET LEVEL position ((*k*) ab e).

(*m*) Repeat (*i*) through (*l*) above at wide
oscillator frequencies of 250 Hz, 1 kHz,
Hz, and 240 kHz.
() *Pcm performance test.*
(*a*) Connect the test equipment as shown
ire 4–186.
(*b*) Set the signal generator frequency to
Hz as indicated on the counter and set
tput level to –90 dbm.
(*c*) Set the receiver controls as follows:

Controls	Settings
CVR CHANNEL	Channel 240
CVR SIG	Channel 240
MTR DUPL	Channel 340
C POWER	ON
eter selector switch	MULT PEAK
ULT PEAK	Tune for maximum meter indication
eter selector switch	RCVR SIG
CVR SIG	Tune for maximum meter indication

(*d*) Record the noise level as indicated
VTVM.
(*e*) Connect the test equipment as shown
ure 4–189.
(*f*) Set the transmitter to channel 340 and
for maximum PWR OUT as described in
) through (*k*) above, but it is not necessary
ord any of the meter indications.
(*g*) Disconnect the transmitter test facility
from the VIDEO connector of the trans-
.
(*h*) Set the signal generator frequency to
Hz as indicated on the counter, and adjust
utput level to obtain the same VTVM
level indication as in (*d*) above.
(*i*) Set test facility switches S1 to ON and
o PCM & TMG.
(*j*) Set the oscilloscope controls as follows:

RIG SLOPE	EXT
RIG MODE	AUTO
IME BASE	0.1 us x 5
AIN SWEEP	NORMAL
MPLIFIERS	0.5v/cm dc (both)

(*k*) Set the transmitter and receiver meter
r switches to their 12 CH PCM position.
(*l*) Reconnect the transmitter test facili-
the transmitter VIDEO connector.
(*m*) Adjust the transmitter INPUT con-
r a 50 percent indication on the transmitter
. The receiver meter should indicate within
reen band. (This corresponds to 180 kHz
ion.)

(*n*) Observe the regenerated pcm signal and the timing pulse as displayed on channel A of the oscilloscope (fig. 4–190). Check the following pulse characteristics:

1. The regenerated pulse amplitude (fig. 4–190A) should be 2.0v ± 0.2v

2. The timing pulse amplitude (fig. 4–190B) should be 2.0v ± 0.2v.

(*o*) Set both oscilloscope amplifiers to 0.2 v/cm dc. Check the following pulse characteristics:

1. The rise time should be between 10 to 50 nanoseconds and the fall time between 20 and 100 nanoseconds (fig. 4–190C).

2. The timing pulse width (T2) should be between 90 and 150 nanoseconds at 50 percent amplitude.

3. The timing pulse rise time (10 to 90 percent amplitude) should be between 10 and 50 nanoseconds.

4. The timing pulse position relative to the regenerated pulse at 50 percent amplitude points (T1) should be less than 80 nanoseconds (fig. 4–190D).

5. The difference T2–T1 should be less than 40 nanoseconds.

(6) *Order wire net gain measurement.*

(*a*) Connect the test equipment as shown in figure 4–191A.

NOTE

Leave the transmitter tuned to channel 340 and the receiver to channel 240 as in the previous test.

(*b*) Set the signal generator to 50 MHz as shown on the counter and adjust the output level for a VTVM noise level indication as recorded in (3)(*a*)*4* above. (corresponding to a received signal of –74 dbm).

(*c*) Connect the test equipment as shown in figure 4–191B.

(*d*) Set the coaxial switch to position 1.

(*e*) Set the wide range oscillator to 1 kHz and adjust the output level for –10 dbm as indicated on the VTVM.

(*f*) Set the coaxial switch to position 2. The VTVM should indicate **-10.5dBm** ± 2 db. The 1-kHz tone should be heard on the order wire handset.

(7) *Order wire deviation test.*

(*a*) Connect the test equipment as shown in figure 4–192.

NOTE

Leave the transmitter tuned to channel 340 and the receiver to channel 240 as in the previous test.

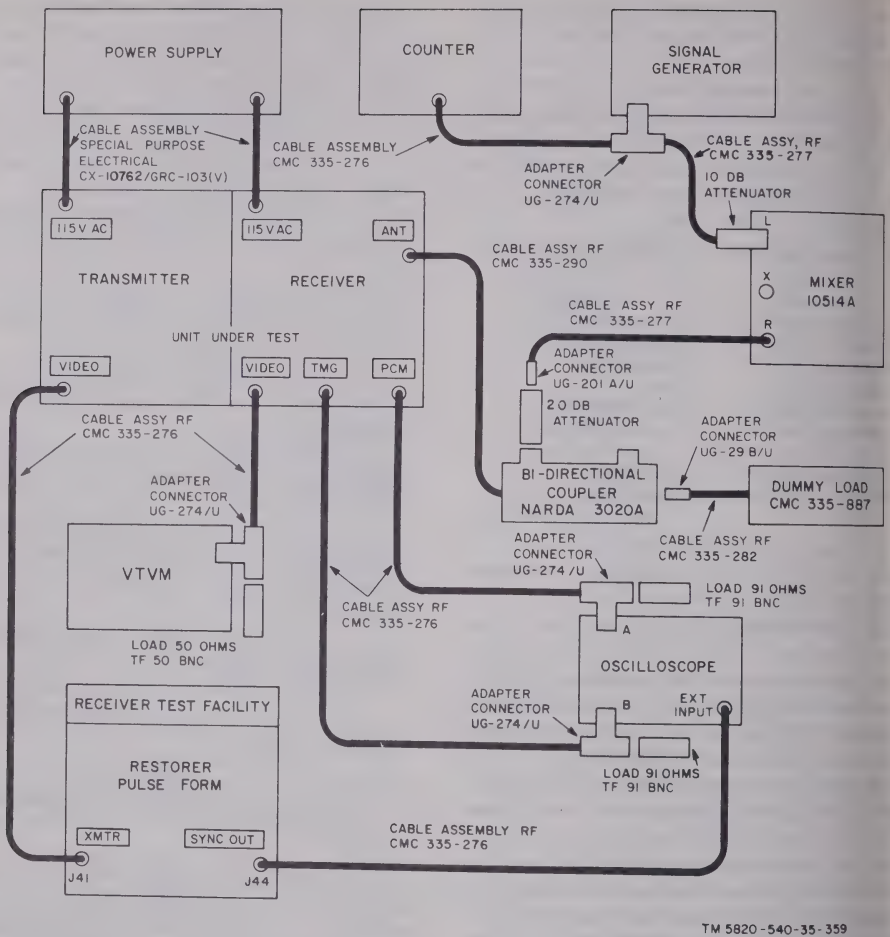


Figure 4-189. Radio set pcm performance test setup.

(*b*) Set the coaxial switch to position 1.

(*c*) Set the wide range oscillator to 1 kHz and adjust the output level for a –10 dbm indication on the VTVM.

(*d*) Set the transmitter test facility switches S1 to ON and S20 to 30 MHz DISCR.

(*e*) Set the coaxial switch to position 2.

(*f*) Set the signal generator frequency at 340 MHz at an output of 0 dbm.

(*g*) Observe test facility meter M1 and fine tune the signal generator for a peak indication. Adjust the attenuator on the signal generator to maintain the M1 indication at 50 percent of full scale. Further tune the signal generator for a midscale indication on test facility meter M2. The deviation as indicated by the unterminated VTVM should be between 45 mv rms +1 mv –6 mv (1 mv rms = 1 kHz peak deviation).

(8) *Order wire 12-channel pcm test.*

(*a*) Connect the test equipment as shown in figure 4–191C.

(*b*) Set the coaxial switch to positi 1.

(*c*) Set the wide range oscillator to 1 Hz as indicated on the counter at an output o –10 dbm as indicated on the VTVM.

(*d*) Set the coaxial switch to positi 2. The VTVM should indicate –10 dbm ± 2 db.

(*e*) Set test facility switches S1 to ON and S15 to NOISE.

(*f*) Set the transmitter and receiver m ter selector switches to their 12 CH PCM posi ns and the transmitter INPUT control to midrange.

(*g*) Adjust the test facility PCM LE EL control for 50 percent indication on the tr s-

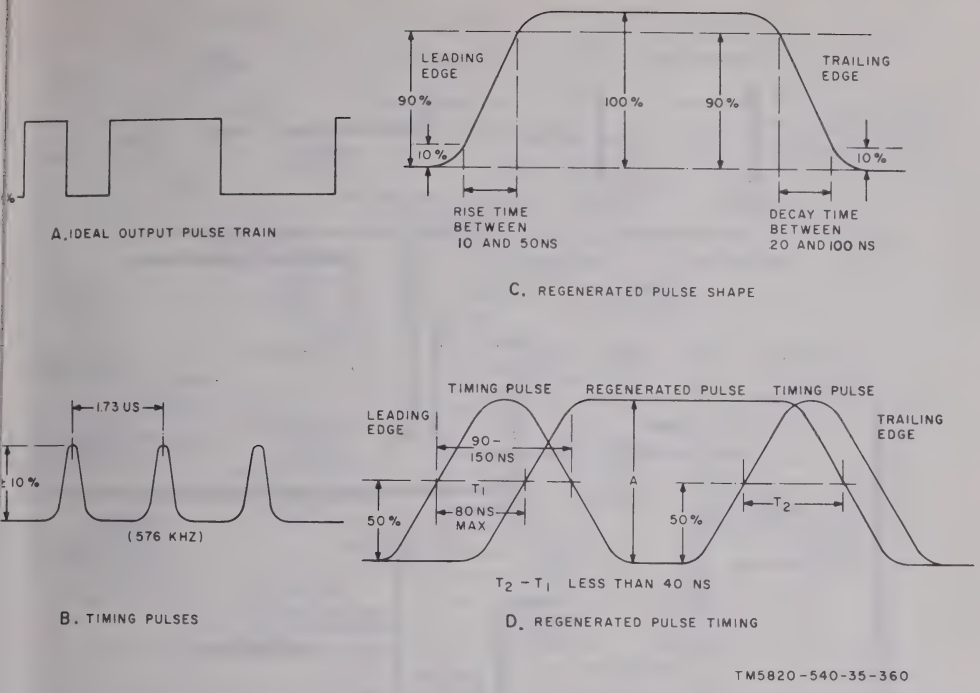


Figure 4-190. Pcm output pulses, oscilloscope display.

meter. The receiver meter should indicate green band. The VTVM indication should dbm ± 2 db.

(*h*) Temporarily remove the 91 ohm load he receiver PCM connector. The receiver should drop to zero. Replace the 91 ohm n the receiver PCM connector. The re- meter should indicate within the green

(*i*) Set the coaxial switch to position 1.

(*j*) Increase the wide range oscillator out-) dbm as indicated on the VTVM.

(*k*) Set the coaxial switch to position 2. the VTVM indication.

(*l*) Disconnect the cable connection at the itter VIDEO connector. The VTVM be within ± 1 db of the indication record- e) above.

) *Order wire 24-channel pcm test.*

(*a*) Connect the test equipment as shown re 4–191C.

(*b*) Set the coaxial switch in position 1.

(*c*) Set the wide range oscillator to 1 kHz cated on the counter at an output of –10 s indicated on the VTVM.

(*d*) Set the coaxial switch to position 2. The VTVM should indicate –10 dbm ± 2 db.

(*e*) Temporarily shortcircuit leads C and D of COMB OW special cable CMC 217–800012 (fig. 5–18). The VTVM indication should drop to zero. Remove the shortcircuit.

(*f*) Disconnect the PIN E lead of special cable CMC 217–800011 (fig. 5–18) from the wide range oscillator.

(*g*) Connect the pin A lead of the COMB OW special cable to the wide range oscillator.

(*h*) Set the coaxial switch to position 1.

(*i*) Set the wide range oscillator to 1.0 kHz and adjust the output level to –4 dbm as indicated on the VTVM.

(*j*) Shortcircuit leads C and D of the COMB OW special cable.

(*k*) Set the coaxial switch to position 2. The VTVM indication should be –16 dbm ± 2 db.

(*l*) Remove the shortcircuit between lead C and D of the COMB OW special cable. The VTVM indication should drop to zero.

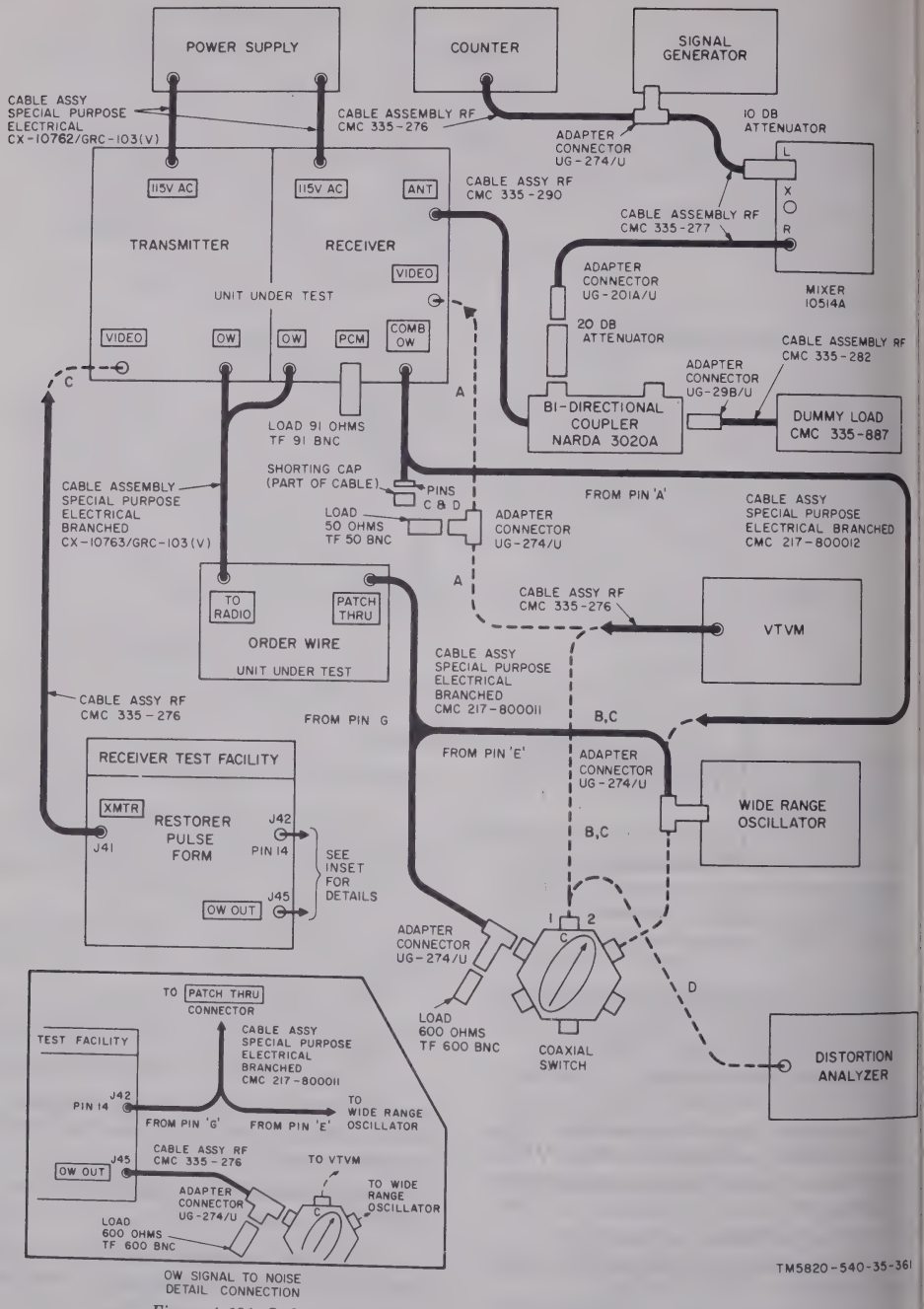


Figure 4-191. Order wire gain, noise level and distortion measurement, test setup.

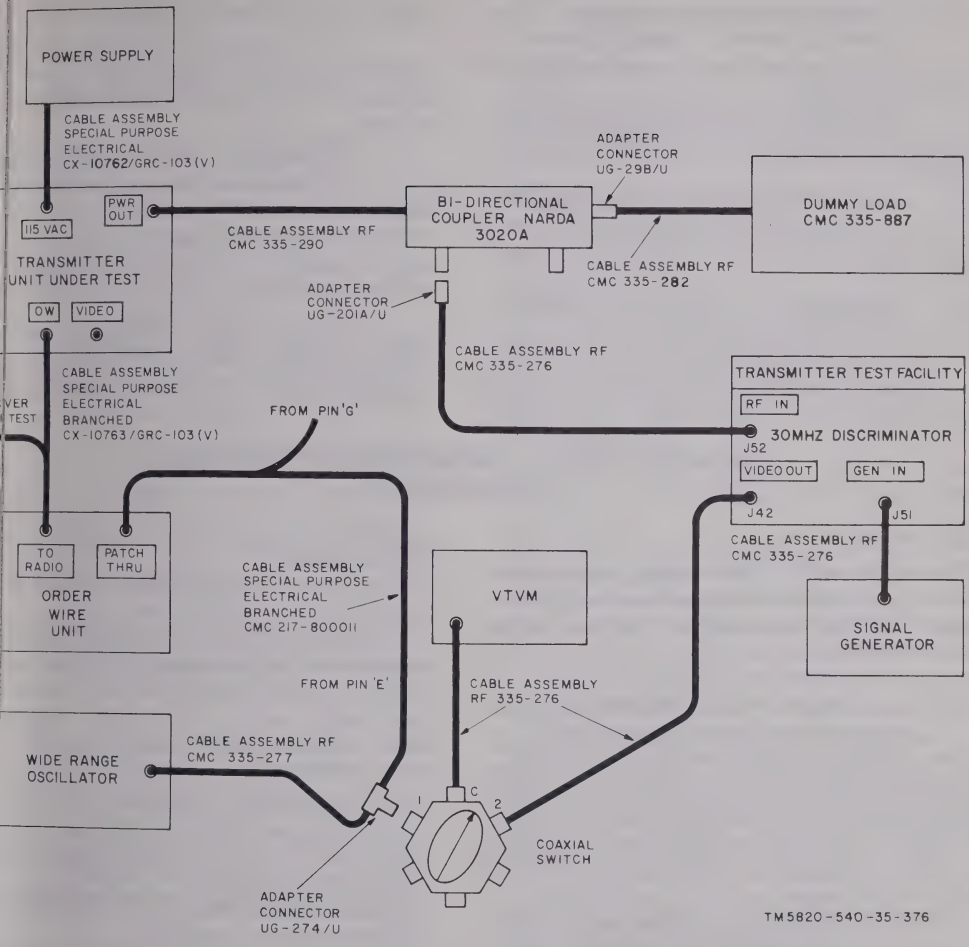


Figure 4-192. Order wire deviation test setup.

) *Order wire harmonic distortion measure-*

(*a*) Connect the test equipment as shown re 4–191B.

(*b*) Disconnect the test facility from the itter VIDEO connector and remove the 91 ad from the receiver PCM connector.

(*c*) Set the coaxial switch to position 1.

(*d*) Set the wide range oscillator to 1 nd adjust the output level to –10 dbm.

(*e*) Replace the VTVM with the distor- nalyzer (fig. 4–191D).

(*f*) Set the coaxial switch to position 2. armonic level should be at least 26 db be- ndamental as measured on the distortion er.

(*g*) Replace the distortion analyzer with the VTVM as shown in figure 4–191B.

(*h*) Repeat steps (*c*) through (*f*) above for a wide range oscillator output level of –5 dbm. The harmonic level should still be more than 26 db below the fundamental.

(11) *Order wire signal-to-noise measurement.*

(*a*) Connect the test equipment as shown in figure 4–191A.

(*b*) Set the signal generator to 50 MHz and adjust the output for a VTVM noise level indication as in (3)(*a*)*5* above (corresponding to –94 dbm signal level).

(*c*) Connect the test equipment as shown in figure 4–191C and connect the test facility and

the order wire unit to the coaxial switch as shown in the test facility detail connection inset.

(*d*) Set the deviation level as follows:

1. Set the test facility switches S1 to ON and S15 to NOISE.

2. Set the transmitter meter selector switch to 12 CH PCM and the INPUT control to midrange.

3. Disconnect the wide range oscillator.

4. Adjust the test facility PCM level control for a 50 percent indication on the transmitter meter.

5. Reconnect the wide range oscillator to the coaxial switch as in figure 4–191C.

(*e*) Set the coaxial switch to position 1.

(*f*) Set the wide range oscillator to 1 kHz at a level of –10 dbm as indicated on the VTVM.

(*g*) Set the coaxial switch to posi n 2. Record the VTVM indication.

(*h*) Disconnect the wide range os ator at the T-connector. The VTVM should i dicate at least 29 db below the level obtained (*g*) above.

(*i*) Reconnect the wide range osc ator.

(*j*) Disconnect the test facility fr the transmitter VIDEO connector.

(*k*) Repeat (*g*) and (*h*) above. The ffer- ence between the two VTVM indications ould be greater than 40 dbm.

(*l*) Repeat (*a*) through (*j*) abov at a signal level of –74 dbm and –54 dbm as in ated by the VTVM noise levels measured in (*a*)4 and (4)(*d*) above.

Section IV. REMOVAL AND REPLACEMENT PROCEDURES, MISCELLANEOUS

4–76. Introduction

Paragraphs 4–77 to 4–103 supplement module removal and replacement procedures in chapter 3, section III. Refer to paragraphs 3–41 to 3–43 for general information.

4–77. Replacement of Rotary Switch 5TR1A1S1

a. Replacement of switch 5TR1A1S1 (fig. 3–1) is a fourth order removal. Electrical frequency synthesizer 5TR1A2, power supply 5TR1PS1, and alarm control 5TR1A3 must be removed first.

b. Remove 5TR1A2, 5TR1PS1 and 5TR1A3 as described in paragraphs 3–45 and, 3–47 in this manual, and chapter 6, TM 11–5820–540–12.

c. On the front panel, loosen the two screws in the switch control knob, and remove the knob.

d. Locate switch 5TR1A1S1 (fig. 3–1). Loosen and remove the nut that secures 5TR1A1S1 to the front panel. Remove the switch from the mounting hole.

e. Unsolder and tag the wires from switch 5TR1A1S1. Refer to figure 6–14.

f. Remove diode CR1 and resistor R3 from the defective switch. Check the diode and the resistor and install them in their correct positions on the replacement switch.

g. Refer to figure 6–14 and use wire of similar gauge to that on the defective switch to interconnect all switch contacts necessary to complete circuit, with the exception of wires removed in *e* above.

h. Position the replacement switch in its mounting hole. Connect and solder the wires, removed in *e* above, to their appropriate terminals.

i. Secure the switch with the hexagon n and the lockwasher.

j. Replace the front panel knob and se re it in position with its two setscrews.

k. Reinstall 5TR1A2, 5TR1PS1, and 5TR1A3 as described in paragraphs 3–45 and 3– and Chapter 6, TM 11–5820–540–12.

4–78. Replacement of INPUT Control 5TR1A1R1

a. Replacement of INPUT control 5TR A1R1 is a third order removal. Electrical fre ency synthesizer 5TR1A2 and power supply 5T 1PS1 must be removed first.

b. Remove 5TR1A2 and 5TR1PS1 as described in paragraphs 3–45 and 3–47.

c. Locate 5TR1A1R1 (fig. 3–1). Unsold and tag the wires from the defective 5TR1A1 .

d. Loosen the two setscrews in the front panel knob and remove the knob.

e. On the front panel, loosen and remo e the hexagon nut that secures R1, and remove e potentiometer.

f. Remove resistor R2 from the defective otentiometer 5TR1A1R1. Install resistor R2 the replacement potentiometer.

g. Install the replacement potentiometer the mounting hole and secure it with the nu provided.

h. Connect and solder the wires remove in *e* above.

i. Rotate the potentiometer fully clockwi ; replace the front panel knob in position wi the indicator dot opposite the last calibration point

HIGH end; secure the knob in position
ts two setscrews.
eplace 5TR1A2 and 5TR1PS1 as described
agraphs 3-45 and 3-47.

Replacement of Meter 5TR1A1M1

eplacement of meter 5TR1A1M1 is a third
removal. Electrical frequency synthesizer
2 and power supply 5TR1PS1 must be re-
first.
emove 5TR1A2 and 5TR1PS1 as described
agraphs 3-45 and 3-47.
ocate meter 5TR1A1M1 (fig. 3-1). Unsol-
d tag the wires from the defective meter.
oosen and remove the four mounting screws
its and remove the meter.
osition the replacement meter and secure
he four nuts and screws.
onnect and solder the wires removed in *c*

eplace 5TR1A2 and 5TR1PS1 as derived
agraphs 3-45 and 3-47.

Replacement of Push Switch 5TR1A1S2

lace radio transmitter 5TR1 bottom side
d locate push switch 5TR1A1S2 (fig. 3-3).
nsolder and tag the three wires from
1S2.
emove the nut and washer that secure
1S2 to the front panel. Remove 5TR1A1-

onnect terminals 2 and 4 of the replace-
witch together using a short piece of wire
ilar gauge to that used on the defective

nstall the new switch and secure it with nut
asher. Connect and solder the wires re-
in *b* above.

Replacement of Rotary Switch 5TR1A1S3

lace radio transmitter 5TR1 top side up and
rotary switch 5TR1A1S3 (fig. 3-1).
emove the control knob by unscrewing its
screws.
emove the nut and washer securing
1S3 to the chassis. Pull the switch free of

nsolder and tag the wires from 5TR1A1S3.
e 5TR1A1S3.
onnect and solder the wires removed in *d*
to the replacement switch.
nstall the switch in its mounting hole and
it with the nut and washer. Replace and
the control knob.

4-82. Replacement of Circuit Breaker 5TR1A1CB1

a. Place radio transmitter 5TR1 bottom side up and locate circuit breaker 5TR1A1CB1 (fig. 3-3).

b. Locate and remove the electrical frequency synthesizer 5TR1A2 as described in paragraph 3-45.

c. Remove and discard the insulating tubing on the circuit breaker 5TR1A1CB1 terminals.

d. Unsolder and tag the wires from 5TR1A1-CB1 terminals.

e. Loosen and remove the hexagonal nut and washer that secure the circuit breaker to the front panel. Remove 5TR1A1CB1.

f. Install the replacement circuit breaker in its mounting hole and secure it with the hexagonal nut and washer.

g. Remove approximately 1 inch of insulation from the ends of the wires to be connected to the circuit breaker.

h. Place a suitable length of heat shrinkable tubing type CMC 334-362/3 over each wire.

i. Wrap the wires around both sides of the hook in the terminals on the circuit breaker. Insure a good mechanical connection and that the wires are connected to the correct terminals with regard to LOAD and LINE.

j. Solder the leads to the terminals.

k. Position the heat shrinkable tubing on the wires, over the terminals and using a thermogun, shrink the tubing to fit snugly over the terminals.

l. Replace electrical frequency synthesizer 5TR1A2 as described in paragraph 3-45.

4-83. Repair of Electrical Connector Assembly 5TR1A1A1 Components

For repair and replacement of connectors and wires in electrical connector assembly 5TR1A1A1 (fig. 6-14), refer to paragraph 4-8 and 4-10).

4-84. Removal of Distribution Box 5A2A1 and Radio Interference Filter 5A2FL1

NOTE

Distribution box 5A2A1 must be removed to repair or replace the associated plugs and wiring.

a. Remove centrifugal fan 5A2B1 (chapter 3, section VIII).

b. Remove the four screws securing J6 (XAR1A2A3P1) to the case.

NOTE

To insure correct alignment when replacing plug J6, note the order in which the washers or shims are placed under J6.

c. Remove the four screws securing the diaphragm to case partition; remove the diaphragm.

d. At the rear of case, remove the eight screws securing radio interference filter 5A2FL1 and distribution box 5A2A1 to case (TM 11–5820–540–12, fig. 6–9).

e. Remove the cable assembly by pulling J6 through the slot in the case partition.

f. Replace the cable assembly by feeding J6 and the cable through the slot in the case partition. Position the shims and washers under J6 in the order noted in *b* above. Secure J6 with the four screws provided.

g. Position radio interference filter 5A2FL1 and distribution box 5A2A1 and secure them with the screws provided.

h. Replace and secure the diaphragm to the case partition.

i. Replace centrifugal fan 5A2B1 **(chapter 3, section VIII).**

4–85. Replacement of Circuit Card Assembly 6AR1A2A2

a. Locate circuit card assembly 6AR1A2A2 (fig. 3–13). Remove the elapsed time indicator by pulling it straight away from the printed circuit board.

b. Unsolder and tag the wires from connecting pins E1 through E10.

c. Remove the four screws securing 6AR1A2A2 to chassis, and remove circuit card assembly 6AR1A2A2.

d. Position replacement board 6AR1A2A2 and secure it with the four screws provided.

e. Connect and resolder the wires removed in *b* above.

f. Reinstall the elapsed time indicator in its sockets.

4–86. Removal of Connector-Filter Assembly 6AR1A2A3

Connector-filter assembly 6AR1A2A3 must be removed in order to replace the filter-connectors located nearest the 6AR1 chassis, or to repair or replace P1 (6AR1A2A3). The filter-connectors located on the side of 6AR1A2A3 which is not secured to the 6AR1 chassis, may be replaced by removing the cover plate on the side of 6AR1A2–A3.

a. Locate connector-filter assembly 6AR1A2A3 (fig. 3–6). Measure as accurately as possible and record the distance from front panel 6MP1 to the rear edge of 6AR1A2A3.

b. Remove the four red-circled screws that secure 6AR1A2A3 to the chassis.

c. Replace connector P1 or the filter-connector as required. Refer to paragraph 4–10 for replacement of connectors.

d. Replace 6AR1A2A3 and secure it with the four screws provided. Before tightening the mounting screws, position 6AR1A2A3 at the same distance measured in *a* above; also check the vertical plane of connector P1 using a square and the top edge of the 6AR1 chassis as a reference.

4–87. Replacement of Filter Assembly 6AR1A2A4

a. Removal Procedure.

(1) Remove control panel 6MP1 as described in paragraph 4–102.

(2) Replace the XMTR TUNE control knob temporarily and tune the transmitter to channel 340. Remove control knob.

(3) Disconnect the three rf leads from 5A5: P1 (6W2J1), P1 (6A5J2), and P1 (XJ6) (fig. 3–6).

(4) Disconnected the five rf leads connected to electronic switch 6A1 connectors J1, J2, J3, J4, and J6.

CAUTION

Do not move the XMTR TUNE control shaft or the flexible shaft on frequency multiplier 6A2.

(5) Loosen the four red-circled screws that secure frequency multiplier assembly 6A2 to the chassis. Carefully slide 6A2 away from the front panel to disengage the flexible drive shaft. Remove 6A2 from the transmitter rf head.

(6) Disconnect the four rf leads connected to filter assembly 6AR1A2A4: P2 (6AR1A2A4–J1), P1 (6AR1A2A4J2), P1 (6AR1A2A4J3), and P2 (6AR1A2A4J4).

(7) Locate filter assembly 6AR1A2A4 (fig. 3–6). Unsolder and tag the two wires from FL1 and FL2 (6AR1A2A4).

(8) Locate low pass filter 6AR1A2FL and disconnect rf lead P2 (XAR1A3J1) (fig. 3–13) and rf lead P1 to 6AR1A1J2 (fig. 3–6).

(9) Loosen the two green-circled mounting screws that secure 6AR1A2FL1 to the chassis. Remove 6AR1A2FL1.

(10) Disconnect rf lead P2 (6AR1A1J1) from 6AR1A1J1 (fig. 3–6).

Locate power monitor 6AR1A3 (fig. remove the four red-circled mounting and remove 6AR1A3.

Release cable CMC 406–219 by removing nting screw of the cable clamp located electronic switch 6A1 and interference AR1A2FL3.

Remove the six mounting screws shown e 4–71. One of the mounting screws is lo- nder the upper right corner of the rubber at the rear of 6AR1A1. Remove the two ng screws shown in figure 3–6.

Carefully lift and tilt the 6AR1 chassis the right-hand cavity of the 6AR1A1 While moving the 6AR1 chassis be sure e remaining interconnecting wires are not

Remove the two mounting screws that filter assembly 6AR1A2A4. Remove 2A4.

placement Procedure.

Secure replacement filter assembly 2A4 with the two mounting screws.

Replace and secure the 6AR1 chassis to R1A1 module with the eight mounting provided. Do not tighten the two screws beside connector-filter assembly 6AR1A2– 3–6).

Install power monitor 6AR1A3 but do hten the four mounting screws at this

Install low pass filter 6AR1A2FL1 and the two mounting screws. Connect P2 A3J1) to P1 of power monitor 6AR1A3, 6AR1A2FL1 to 6AR1A1J2, and P2 A1J1) to 6AR1A1J1.

Reconnect and solder the wires to FL1 2 of 6AR1A2A4. Connect the rf leads to 2A4 as shown below:

Rf lead	Connects to 6AR1A2A4 connector
R1A2A4J1)	J1
R1A2A4J2)	J2
R1A2A4J3)	J3
R1A2A4J4)	J4

Secure the clamp on cable CMC 406– 6AR1 chassis with the screw provided.

Lower frequency multiplier assembly refully into position and secure it with r screws provided. Connect the rf leads as below.

Rf lead	Connects to connector
P4 (XA1J1)	J1 (6A1)
P3 (XA1J2)	J2 (6A1)
P2 (XA1J3)	J3 (6A1)
P1 (XA1J4)	J4 (6A1)
P1 (XA1J6)	J6 (6A1)
P2 (6W2J1)	6W2J1
P1 (6A5J2)	J2 (6A5)

(8) Replace control panel 6MP1 as described in paragraph 4–102.

(9) Install dust cover 6MP2 and secure it with the screws and washers provided.

(10) Slide Amplifier-Frequency Multiplier AM–4320/GRC–103(V) slowly into the transmitter case which has two holes drilled through the rear of the case as shown in figure 4–193.

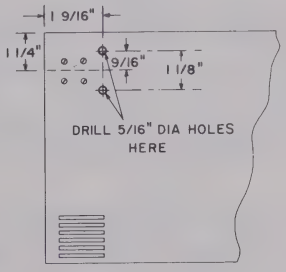


Figure 4-193. Transmitter case CY–4637/GRC–103(V) partial rear view showing location of access holes.

(11) Secure the unit by tightening the four front panel screws.

(12) Insert a screwdriver through the holes in the rear of the case and tighten the two mounting screws left loose in (2) above.

4–88. Replacement of Radio Interference Filter, 6AR1A2FL3

a. Repeat paragraph 4–87 *a* (1) through (8).

b. Disconnect P1 (6AR1A2A4J2) from filter assembly 6AR1A2A4 connector J2.

c. Repeat paragraph 4–87 *a* (11) through (15).

d. Locate 6AR1A2FL3 (fig. 3–6), unsolder and tag the wires from E1, E2, and E3 of 6AR1A2FL3.

e. Lift and tilt the 6AR1 chassis toward the right hand cavity of the 6AR1A1 module. While moving the 6AR1 chassis be sure that the remaining interconnecting wires are not broken.

f. Remove the two nuts securing radio interference filter 6AR1A2FL3 to the chassis. Remove the defective 6AR1A2FL3.

g. Install the replacement 6AR1A2FL3 and secure it with the two nuts provided.

h. Repeat paragraph 4–87 *b* (2) through (4).

i. Connect rf lead P1 (6AR1A2A4J2) to filter assembly 6AR1A2A4 connector J2.

j. Repeat paragraph 4–87 *b* (6) through (12).

4–89. Replacement of Channel Frequency Indicator 6AR1A1DS1

a. Removal and Replacement Procedure.

(1) Remove control panel 6MP1 as described in paragraph 4–102.

(2) Remove the four red-circled mounting screws that secure the defective channel frequency indicator to the chassis.

(3) Grasp the channel frequency indicator and slide the unit sideways to disengage the flexible shaft. Remove the defective channel frequency indicator.

(4) Remove the flexible shaft from the defective channel frequency indicator.

NOTE

The two set screws in the flexible shaft are held in place with Loctite. Melt the Loctite before loosening the set screws.

(5) Install the flexible shaft to the replacement channel frequency indicator.

(6) Slip the other end of the flexible shaft over the hexagonal shaft. Place the channel frequency indicator in position on the chassis and secure it with the mounting screws.

(7) Position the flexible shaft equally between the channel frequency indicator and the hexagonal shaft. Secure the flexible shaft to the channel frequency indicator with the two set screws. Lock the set screws as described in paragraph 4–13.

(8) Loosen the four mounting screws, remove the channel frequency indicator from the chassis, and proceed with alignment procedures described in *b* below.

b. Alignment Procedure.

(1) Connect plug P1 (6W1J2) at the end of control-indicator 6A3 cable to connector 6W1J1.

(2) Set the XMTR CHANNEL control to channel 320.

(3) Connect the transmitter rf head to the test facility as shown in figure 4–52A.

(4) Set the test facility switches as follows:

Switch	Switch position	Normal indication
S1	ON	
S20	S12	
S12	OSC	Test facility meter M1 indicates between 25% and 90% of full scale deflection.

(5) Check the 115v ac on the power supply (part of the accessory kit); adjust if required.

(6) Set the test facility switches as follows:

Switch	Switch position	Normal indication
S12	DBLR	M1 indicates between 25% and 90% of full scale.
S12	MULT	M1 indicates between 25% and 90% of full scale.
S13	ON	

(7) Recheck 115v ac on the power supply; readjust if required.

(8) Install the XMTR TUNE control knob and tune for maximum output.

(9) Set test facility switch S12 to the DRIVER position. Push in the PWR OUT PEAK control and tune for maximum indication on meter M1. Meter M1 should indicate between 25 percent and 90 percent of full scale.

(10) Set test facility switch S12 to the PWR OUT position. Pull out the PWR OUT PEAK control and tune for maximum indication on meter M1. The meter should indicate between 25 percent and 90 percent of full scale.

(11) Set test facility switch S1 to OFF.

NOTE

Do not move the XMTR Tune control after the power amplifier has been peaked.

(12) On the replacement channel frequency indicator 6AR1A1DS1, rotate the flexible shaft clockwise until 320 is in line with the calibration mark (notch) on the metal frame.

(13) Hold the channel frequency indicator tape firmly and slip the flexible shaft over the hexagonal-ended shaft. Secure 6AR1A1DS1 to the chassis with the four mounting screws provided.

NOTE

The flexible shaft may have to be moved slightly while installing the assembly to fit the hexagonal-ended shaft.

(14) Set test facility switch S1 to ON. Readjust the XMTR TUNE and PWR OUT PEAK controls for maximum output. Check to see that the channel frequency indicator number 320 is not

an one-eighth inch above or below the
ra on mark (notch) on 6AR1A1DS1. If
ss y, remove 6AR1A1DS1 and readjust the
po ition.
15 Set the XMTR TUNE and XMTR
NEL controls to indicate channel 40 in
wh the calibration mark.
16 Set test facility switch S12 to the
VR position. On the transmitter rf head,
e PWR OUT PEAK control and tune
ma imum meter indication on test facility
r 1.
17 Set switch S12 to PWR OUT. Pull out
PWR OUT PEAK control and tune for
m m reading on meter M1. The level
su ed by the wattmeter should be greater
3 watts.
18 Repeat (15) through (17) above for
ns 100, 200, and 410. Check to see that the
be of the channel being checked is not more
12-inch above or below the calibration mark.
19 Restore the test facility switches to nor-
al disconnect plug P1 (6W1J2) from con-
or W1J1.
20 Install control panel 6MP1 as described
a agraph 4–102.

0. Replacement of Rotary Switch 1RE1A1S1

Place radio receiver 1RE1 top side up and
e otary switch 1RE1A1S1 (fig. 3–29).
Remove power supply 1RE1PS1 as de-
e in Chapter 6, TM 11–5820–540–12.
On the front panel, loosen the two setscrews
secure the control knob of 1RE1A1S1. Re-
he control knob.
Remove the nut and washer that secure
1A1S1 to the front panel.
Remove rotary switch 1RE1A1S1 from its
ng hole. Unsolder and tag the wires from
E1A1S1 terminals.
Refer to figure 6–29 and use wire of similar
as that on the defective switch to connect
tch contacts necessary to complete the cir-
ith the exception of the wires removed in
.
osition the replacement switch in its mount-
le. Connect and solder the wires removed
ove.
ecure the switch to the front panel with
t and washer.
eplace the front panel knob and secure it
ition with its two set screws.
eplace power supply 1RE1PS1 as described
pter 6, TM 11–5820–540–12.

4–91. Replacement of Push Switch 1RE1A1S2

a. Place radio receiver 1RE1 bottom side up and locate push switch 1RE1A1S2 (fig. 3–32).

b. Remove electrical frequency synthesizer 1RE1A2 as described in paragraph 3–56.

c. Remove the protective cover from the rear of 1RE1A1S2.

d. Unsolder and tag the wires from the 1RE1A1S2 terminals.

e. Remove the nut and washer that secure 1RE1A1S2 to the front panel. Remove 1RE1A1S2.

f. Connect terminals 2 and 4 of the replacement switch together, using a short piece of wire of similar gauge to that used in the defective switch.

g. Install the new push switch and secure it with the nut and washer.

h. Connect and solder the wires removed in *d* above.

i. Place the protective cover over the rear of the switch and secure it with a piece of cord.

j. Replace electrical frequency synthesizer 1RE1A2 as described in paragraph 3–56.

4–92. Replacement of Rotary Switch 1RE1A1S3

a. Place radio receiver 1RE1 top side up and locate rotary switch 1RE1A1S3.

b. Remove the control knob by loosening its two setscrews.

c. Remove the nut and washer that secure 1RE1A1S3 to the chassis. Pull the switch free of 1RE1.

d. Unsolder and tag the wires from 1RE1A1S3. Remove 1RE1A1S3.

e. Connect and solder the wires removed in *d* above to the replacement switch.

f. Install the switch in the mounting hole and secure it with the nut and washer. Replace and secure the control knob.

4–93. Replacement of Meter 1RE1A1M1

a. Place radio receiver 1RE1 top side up and locate meter 1RE1A1M1 (fig. 3–29).

b. Remove power supply 1RE1PS1 as described in Chapter 6, TM 11–5820–540–12.

c. Unsolder and tag the wires from meter 1RE1A1M1.

d. Loosen and remove the four mounting screws and nuts that secure 1RE1A1M1 to the front panel. Remove 1RE1A1M1.

e. Install the replacement meter and secure it with the four nuts and screws.

f. Connect and solder the wires, removed in *e* above, on their appropriate terminals on the new meter.

g. Replace power supply 1RE1PS1 as described in Chapter 6, TM 11–5820–540–12.

4–94. Replacement of Circuit Breaker 1RE1A1CB1

a. Place radio receiver 1RE1 bottom side up and locate circuit breaker 1RE1A1CB1 (fig. 3–32).

b. Locate and remove electrical frequency synthesizer 1RE1A2 as described in paragraph 3–56.

c. Remove and discard the insulating tubing on the circuit breaker 1RE1A1CB1 terminals.

d. Unsolder and tag the wires from the 1RE1A1CB1 terminals.

e. Loosen and remove the hexagonal nut and washer that secure the circuit breaker to front panel. Remove 1RE1A1CB1.

f. Install the replacement circuit breaker in the mounting hole and secure it with the hexagonal nut and washer.

g. Remove approximately 1 inch of insulation from the ends of the wires to be connected to the circuit breaker.

h. Place a suitable length of heat shrinkable tubing type CMC 334–362/3 over each wire.

i. Wrap the wires around both sides of the hook in the terminals on the circuit breaker. Insure good mechanical connection and that the wires are connected to the correct terminals with regard to LOAD and LINE.

j. Solder the leads to the terminals.

k. Position the heat shrinkable tubing on the wires, over the terminals and, using a thermogun, shrink the tubing to fit snugly over the terminals.

l. Secure the cable assembly below 1RE1A1CB1 by passing the cord attached to the cable assembly between 1RE1A1CB1 and the front panel and tying firmly.

m. Replace electrical frequency synthesizer 1RE1A2 as described in paragraph 3–56.

4–95. Replacement of Electrical Connector Assembly 1RE1A1A1 Components

For repair and replacement of connectors and wires in electrical connector assembly 1RE1A1A1 (fig. 6–29), refer to paragraphs 4–8 and 4–10.

4–96. Replacement of Circuit Card Assembly 1RE1A1A3

a. Place radio receiver 1RE1 top side up and locate circuit card assembly 1RE1A1A3.

b. Remove power supply 1RE1PS1 as described in Chapter 6, TM 11–5820–540–12.

c. Remove the two mounting screws that secure 1RE1A1A3 to the mounting posts of the chassis.

d. Unsolder and tag the wires from 1RE1A1A3. Remove 1RE1A1A3.

e. Connect and solder the wires to the replacement circuit card assembly 1RE1A1A3.

f. Position 1RE1A1A3 on the mounting posts and secure with the two screws.

g. Replace power supply 1RE1PS1 as described in Chapter 6, TM 11–5820–540–12.

4–97. Removal of Distribution Box 1A2A1

a. Remove the four screws that secure J10 (XA1A3P3) and its mounting bracket to the receiver case.

b. At the rear of the case remove the eight screws that secure distribution box 1A2A1 to the case.

c. Remove the distribution box and the cable assembly by pulling J10 (XA1A3P3) through the slot in the case partition.

d. Proceed with required repairs. Avoid removal of J10 (XA1A3P3) from its mounting bracket. However if J10 (XA1A3P3) has to be removed, before reinstalling the distribution box and cable assembly, realign J10 (XA1A3P3) as follows:

(1) Secure J10 to the mounting bracket with the four mounting screws sufficiently to hold the plug firmly but allow movement with some pressure.

(2) Connect J10 (XA1A3P3) to 2A1A3P3 of the receiver rf head and adjust J10 (XA1A3P3) until the connectors are aligned.

(3) Carefully remove J10 (XA1A3P3) from the receiver rf head and tighten the four mounting screws.

(4) Reconnect J10 (XA1A3P3) to 2A1A3P3 to check the alignment. Repeat (2) and (3) above until the alignment is satisfactory.

e. Replace the distribution box and the cable assembly by feeding J10 (XA1A3P3) through the slot in the case partition. Secure J10 (XA1A3P3) to the case with the four screws.

f. Hold the distribution box in place and secure it with the eight screws from the rear of the case.

98. Replacement of Impedance Matching Network 2A1A1Z1

a. lace the receiver rf head rear side down; ate and remove control panel 2A1MP2 (fig. 16) as described in paragraph 4–99.

b. ocate the T-junction from 2A1A1Z1 (fig. 16) Disconnect the T-junction from 2A1A1– an 2A1A1Z6 as described below:

(1) Refer to figure 4–194; hold connector on 2A1A1A1AZ6 firmly with a wrench. The nnector must not be allowed to turn.

(2) Loosen nut A sufficiently to disengage e connector. It may be necessary to heat the t ith a soldering iron to break the seal rm d by the Glyptol.

(3) Gently pull the wire and nut away from e connector.

(4) Repeat (1) through (3) above to re- ve he T-connector from 2A1A1A1Z4.

c. isconnect P2 (XA1A1Z1J1) from J1 of 1A Z1.

d. emove the two 2A1A1Z1 mounting screws g. –16) and the stud support.

e. emove the 2A1A1Z1 unit by sliding it va ls the rear of the rf head then out through e acess hole in the left side of the chassis.

f. eplace the 2A1A1Z1 unit by inserting it rou h the access hole at the left side of the as s. Slide the unit toward the front of the cei er rf head until the mounting holes appear twe n tuned cavities 2A1A1A1Z5 and 2A1A1– Z

NOTE

When connected, the short end cable from 2A1A- 1 goes to receiver filter Z4 and the longer ed cable to transmitter filter Z6.

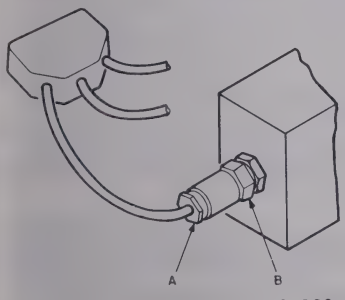


Figure 4-194. Impedance matching network 2A1A1Z1 connector.

g. Insert the two mounting screws through the stud support and then into the mounting holes of the unit.

h. Secure the 2A1A1Z1 unit to tuned cavities 2A1A1A1Z5 and 2A1A1A1Z6 by tightening the two mounting screws.

CAUTION

Do not allow the connectors to turn and do not overtighten the nuts.

i. Insert the ends of the T-junction into the connectors on tuned cavities 2A1A1A1Z4 and 2A1A1A1Z6. Refer to figure 4–194; hold the connectors (B) firmly with a wrench and tighten the nuts (A) in turn.

j. Seal the threads on the nuts with Glyptol.

k. Connect the test equipment as shown in figure 4–136B.

l. Repeat paragraph 4–57 *b* (5)(*b*). Slightly adjust C2 (2A1A1Z1) for minimum vswr.

m. Disconnect the cable from J1 (2A1A1Z1) and connect P2 (XA1A1Z1J1) (fig. 3–16) to J1 (2A1A1Z1).

4–99. Replacement of Control Panel 2A1MP2

a. Place the receiver rf head rear side down, and locate control panel 2A1MP2 (fig. 4–16).

b. Locate and loosen the two screws that secure P1 (2A1W4J4) to 2A1W4J4 (fig. 3–16). Remove P1 (2A1W4J4).

c. Release the cable that is connected to P1 (2A1W4J4) by removing the screws that secure the cable clips (TM 11–5820–540–12, fig. 6–13) to the chassis.

d. Loosen the screws in the three control panel knobs; MULT PEAK, RCVR SIG, and XMTR CUPL. Remove the control knobs.

e. Using a socket wrench, remove the two nuts that secure the ANT. and FROM XMTR connectors to the control panel. Pull the connectors away from the control panel.

f. Loosen the eight mounting screws that secure control panel 2A1MP2 to the chassis. Remove the control panel.

g. To reinstall 2A1MP2, hold the control panel and the cable that is connected to P1 (2A1W4J4) so that the cable will be located at the bottom of the rf head when the control panel is replaced.

h. Place control panel 2A1MP2 in the correct position on the chassis so that the mounting holes are properly aligned. Secure 2A1MP2 with the eight mounting screws.

i. Insert the connectors through the ANT and FROM XMTR mounting holes and secure them with the nuts and washers removed in *e* above.

j. Replace and secure the control knobs. Make sure that the backs of the RCVR SIG and XMTR DUPL knobs clear the control panel by one-eighth inch.

k. Connect P1 (2A1W4J4) to 2A1W4J4 and secure the plug in position with the two screws.

l. Secure the cable to the chassis using the two cable clips.

4–100. Replacement of Frequency Multiplier 2A1A2A1

a. Removal and Replacement.

(1) Place the receiver rf head top side up and locate 2A1A2A1 at the top front, left side (fig. 3–18). Disconnect the P2 rd lead from the J1 (2A1A3P2) connector of 2A1A2A1 and the P2 (2A1A2A3J3) rf lead of 2A1A2A1 from connector J3 of bandpass filter assembly 2A1A2A3.

(2) Loosen the Allen screw on the coupling between the 2A1A2A1 shaft and the flexible drive shaft.

(3) Loosen the three red-circled screws that secure 2A1A2A1 to the chassis. Lift 2A1A2A1 up from the chassis to disengage its chassis connector and flexible drive shaft.

(4) To install the replacement 2A1A2A1 unit first set the receiver rf head RCVR CHANNEL and RCVR SIG controls to channel 400.

(5) Set the cam of the 2A1A2A1 replacement so that the line on the cam identified by the letter H is adjacent to and in line with the cam-follower stud in the body of 2A1A2A1.

(6) Position 2A1A2A1 on the chassis and press straight down to engage the connectors. Tighten the three red-circled screws.

(7) Connect rf lead P2 (2A1A2A3J3) to connector J3 of bandpass filter assembly 2A1A2A3, and the P2 rf lead to the J1 (2A1A3–P2) connector of 2A1A2A1.

b. Alignment Procedure.

(1) Connect the equipment as shown in figure 4–195.

(2) Set the test facility switches as follows:

Switch	Position
S1	ON
S5	S6
S6	MULTIPLIER
S7	AGC

(3) Be sure that SYNTHESIZER FREQUENCY switch S8 is set to OFF.

(4) Tune the receiver rf head MULT PEAK control for a maximum reading on test facility meter M1.

(5) Carefully rotate the cam of 2A1A2A1 until a maximum reading is obtained on the meter. Hold the cam in this position.

(6) Slide the coupling of the flexible drive shaft over the shaft of 2A1A2A1. Tighten the Allen screw in the flexible drive shaft coupling.

(7) Set the RCVR CHANNEL and RCVR SIG controls to channel 40.

(8) Tune the MULT PEAK knob for maximum indication on test facility meter M1. The meter should indicate between 25 percent and 90 percent of full scale.

(9) If the meter indication in (8) above is below normal, reset the RCVR CHANNEL and RCVR SIG controls to channel 400, and repeat (4) through (8) above.

(10) Repeat (7) through (9) above for channels 119 and 120.

(11) Set test facility switch S1 to OFF.

4–101. Removal of Connector-Filter Assembly 2A1A3

Connector-filter assembly 2A1A3 must be removed in order to permit replacement of the filter-connectors or 2A1A3P3.

a. Place the receiver rf head rear side up and locate filter-connector assembly 2A1A3 (fig. 3–18).

CAUTION

The two locating pins on the sides of 2A1A3P3 are factory aligned and should never be loosened or removed.

b. Remove the four screws that secure 2A1A3 to chassis XA1A3. Pull 2A1A3 free of the chassis.

c. Replace the filter-connectors as required. Refer to paragraph 4–9 and figure 6–1 for replacement of filter-connectors.

d. If 2A1A3P3 requires replacement, unsolder and tag the wires from the pins. Refer to paragraph 4–10 and figure 6–18 for replacement of connectors.

e. Remove the four screws that secure 2A1A3–P3 to the assembly. Remove 2A1A3P3 from the assembly.

f. Install the replacement 2A1A3P3 and secure it with the four mounting screws provided.

g. Connect and solder the wires removed in *d* above.

h. Place 2A1A3 in position on the chassis and secure it with the four screws provided.

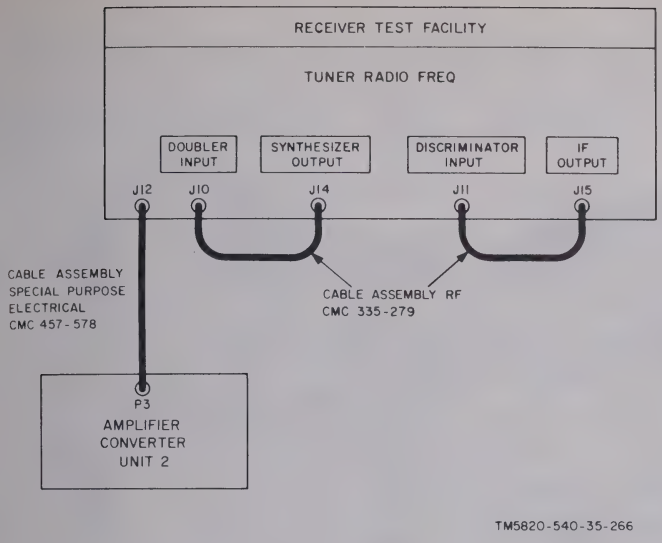


Figure 4-195. Frequency multiplier 2A1A2A1 installation check test setup.

O. Replacement of Control Panel 6MP1

Removal Procedure.

(1) Remove the XMTR TUNE and the R OUT PEAK control knobs.

(2) Remove the hexagon nut and washer n he PWR OUT connector.

(3) Loosen the two screws that secure plug (W1J2) to its mating connector 6W1J2 –6) and disconnect the plug.

(4) Loosen and remove the six mounting w located at the rear of the panel and re- control panel 6MP1.

eplacement Procedure.

(1) Place control panel 6MP1 in position scure it with the six mounting screws pro- d

(2) Connect plug P1 (6W1J2) of the con- idicator 6A3 cable to connector 6W1J2. Se- he plug in position with the two screws ied.

3) Replace and secure the nut and washer h PWR OUT connector. Tighten the power ir 6AR1A3 mounting screws. Install the T TUNE and PWR OUT PEAK control e knobs.

C. Replacement of Channel Frequency Indicators 2A1A1A1DS1 and 2A1A1A1DS2

emoval and Replacement Procedure.

1) Remove control panel 2A1MP2 as de- bd in paragraph 4-99.

(2) Loosen the two set screws that secure the flexible shaft at the coupling end (fig. 4-196).

NOTE

The two set screws are held in place by Loctite. Melt the Loctite before loosening the screws.

(3) Remove the four red-circled mounting screws that secure the defective channel frequency indicator to the chassis.

(4) Grasp channel indicator and slide it sideways to disengage the flexible shaft. Remove the defective channel frequency indicator.

(5) Remove the pin through the flexible shaft and remove the flexible shaft.

(6) Install the flexible shaft on the replacement channel frequency indicator.

(7) Slip the other end of the flexible shaft over the other shaft, place the channel frequency indicator in position and secure with the four mounting screws. Tighten the two set screws.

(8) Using the flexible shaft pin holes as guides drill a hole through the channel frequency indicator shaft end and press the pin through.

b. Channel Frequency Indicator 2A1A1A1DS1 (RCVR CHANNEL), Alignment Procedure.

(1) Connect the test equipment as shown in figure 4-136B.

(2) Install the RCVR SIG control knob and rotate it fully clockwise.

(3) Adjust the sweep generator until the receiver filter response is centrally displayed on the oscilloscope.

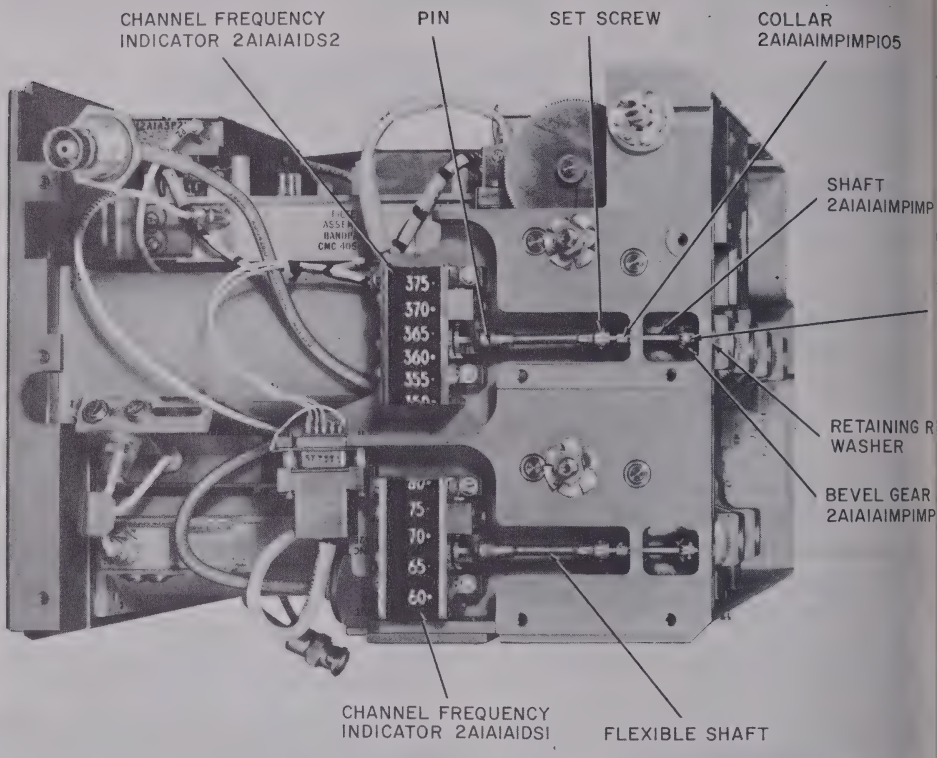


Figure 4-196. Receiver rf head, front view with front panel removed.

(4) With the aid of the markers, adjust the RCVR SIG control until the maximum amplitude (center) of response is tuned to exactly 405 MHz as shown on the oscilloscope.

NOTE

Do not move the RCVR SIG control beyond this step.

(5) Loosen the two setscrews and, using the flexible shaft, turn the tape clockwise until 410 is in line with the cablibration mark.

(6) Holding the channel frequency indicator tape firmly in place tighten the two set screws to secure the flexible shaft.

(7) Check the alignment of the tape every 20 channels down to channel 40. Check to see that the indicated channel and the frequency are in the following relationship:

$$\text{Channel number} = 2\,(\text{Frequency (MHz)} - 200)$$

$$\text{Frequency (MHz)} = \frac{\text{Channel Number}}{2} + 200)$$

NOTE

When the RCVR SIG control is tuned to chan 70, set the XMTR DUPL control to channel 4.

(8) If at any point the alignment i off, adjust the shaft slightly at that frequency a repeat (7) above.

c. Channel Frequency Indicator 2A1A1A DS2 (XMTR DUPL), Alignment Procedure.

(1) Connect the test equipment as shon in figure 4-136C.

(2) Install the XMTR DUPL control knob and rotate it fully clockwise.

(3) Adjust the sweep generator until the ...smitter filter response is centrally displayed ...he oscilloscope.

(4) With the aid of the markers, adjust the TR DUPL control until the maximum ampli- ...e (enter) of the response is tuned to ex- ...y 5 MHz as shown on the oscilloscope.

NOTE

Do not move the XMTR DUPL control beyond thi point.

(5) Proceed with *b* (6) through (8) above.

NOTE

W...n the XMTR DUPL control is tuned to chan- ...ne 70, set the RCVR SIG control to channel 410.

04 Replacement of Push Switch 9A2S1

...Remove monitor panel 9A2 as described in ...agraph 3–7.

...Unsolder and tag the wires from 9A2S1.

...Loosen and remove the hexagonal nut and ...he that secure 9A2S1 to the monitor panel; ...ov 9A2S1.

...Connect terminals 5 to 6 and 7 to 8 on the ...switch, using wire of similar gauge as that on the defective switch. Refer to figure 6–30.

e. Install the new push switch in the mounting hole and secure it with the hexagonal nut and washer.

f. Connect and solder the wires removed in *b* above.

g. Replace and secure control panel 9A2.

4–105. Replacement of Toggle Switch 9A2S2

a. Remove monitor panel 9A2 as described in paragraph 3–7.

b. Loosen and remove the hexagonal nut and washer that secure 9A2S2 to the mounting bracket.

c. Pull 9A2S2 free from the mounting bracket. Unsolder and tag the wires from 9A2S2.

d. Connect terminal 2 to 4 on new switch using wire of similar gauge as that used on defective switch. Refer to figure 6–30.

e. Connect and solder wires removed in *c* above.

f. Install the new switch in its mounting hole secure it with the hexagonal nut and washer.

g. Replace and secure control panel 9A2.

TEST POINT	TYPICAL INDICATION	
	DISPLAY	AMPLITUDE PEAK-TO-PEAK
Q6 BASE		4 VOLTS

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Figure 4-197 (1). Synthesizer waveforms (part 1 of 16).

TEST POINT	TYPICAL INDICATION		
	DISPLAY	FREQUENCY	AMPLITUDE PEAK-TO-PEAK
TP2		66 MHz	1.5 VOLTS
TP3		33 MHz	3.0 VOLTS
TP4		16.5 MHz	1.6 VOLTS
Q1 BASE		66 MHz	0.15 VOLTS
Q2 BASE		66 MHz	1.25 VOLTS
Q5 BASE		33 MHz	0.5 VOLTS
Q8 BASE		16.5 MHz	0.5 VOLTS
Q11 BASE		8.25 MHz	0.75 VOLTS
Q11 COLLECTOR		8.25 MHz	4.0 VOLTS

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Figure 4-197 (2). Synthesizer waveforms (part 2 of 16).

TEST POINT	TYPICAL INDICATION		
	DISPLAY	FREQUENCY	AMPLITUDE PEAK-TO-PEAK
BINARY A7, PIN 10		8.25 MHz	4 VOLTS
BINARY A7, PIN 3		4.125 MHz	5 VOLTS
BINARY A8, PIN 3		2.0625 MHz	5 VOLTS
BINARY A9, PIN 8		1.0312 MHz	4 VOLTS

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Figure 4-197 (3). Synthesizer waveforms (part 3 of 16).

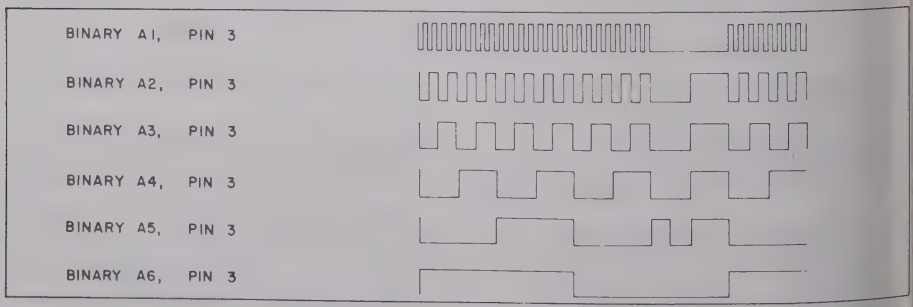

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Figure 4-197 (4). Synthesizer waveforms (part 4 of 16).

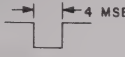
TEST POINT	TYPICAL INDICATION	
	DISPLAY	AMPLITUDE PEAK-TO-PEAK
COLLECTORS OF Q1 THRU Q6		4 VOLTS

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Figure 4-197 (5). Synthesizer waveforms (part 5 of 16).

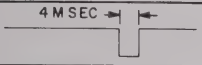
TEST POINT	TYPICAL INDICATION	
	DISPLAY	AMPLITUDE PEAK-TO-PEAK
PIN 3 OF BINARIES A1 THRU A6		4 VOLTS

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Figure 4-197 (6). Synthesizer waveforms (part 6 of 16).

TEST POINT	TYPICAL INDICATION	
	DISPLAY	AMPLITUDE PEAK-TO-PEAK
CONTACT 2 OF J6A (515.625 KHz GATED BY CLOCK PULSE A)		4 VOLTS
BINARY A1, PIN 3		4 VOLTS
BINARY A2, PIN 3		4 VOLTS
BINARY A3, PIN 3		4 VOLTS
BINARY A4, PIN 3		4 VOLTS
BINARY A5, PIN 3		4 VOLTS
BINARY A6, PIN 3		4 VOLTS
BINARY A7, PIN 3		4 VOLTS
BINARY A8, PIN 3		4 VOLTS
BINARY A9, PIN 3		4 VOLTS
PIN 7 OF BINARIES A1 THRU A9		4 VOLTS

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Figure 4-197 (7). Synthesizer waveforms (part 7 of 16).

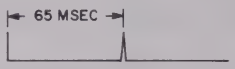
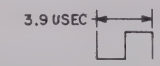
TEST POINT	TYPICAL INDICATION	
	DISPLAY	AMPLITUDE PEAK-TO-PEAK
PIN 3 OF BINARIES A4 THRU A9		4 VOLTS
TP7 OF EXTENDER BOARD		2 VOLTS
BINARY A10, PIN 2		2 VOLTS
BINARY A10, PIN 7		4 VOLTS
BINARY A10, PIN 8		4 VOLTS
BINARY A10, PIN 9		4 VOLTS
NOR GATE A10, PIN 10 (515.625 KHz GATED BY CLOCK PULSE A)		4 VOLTS

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Figure 4-197(8). Synthesizer waveforms (part 8 of 16).

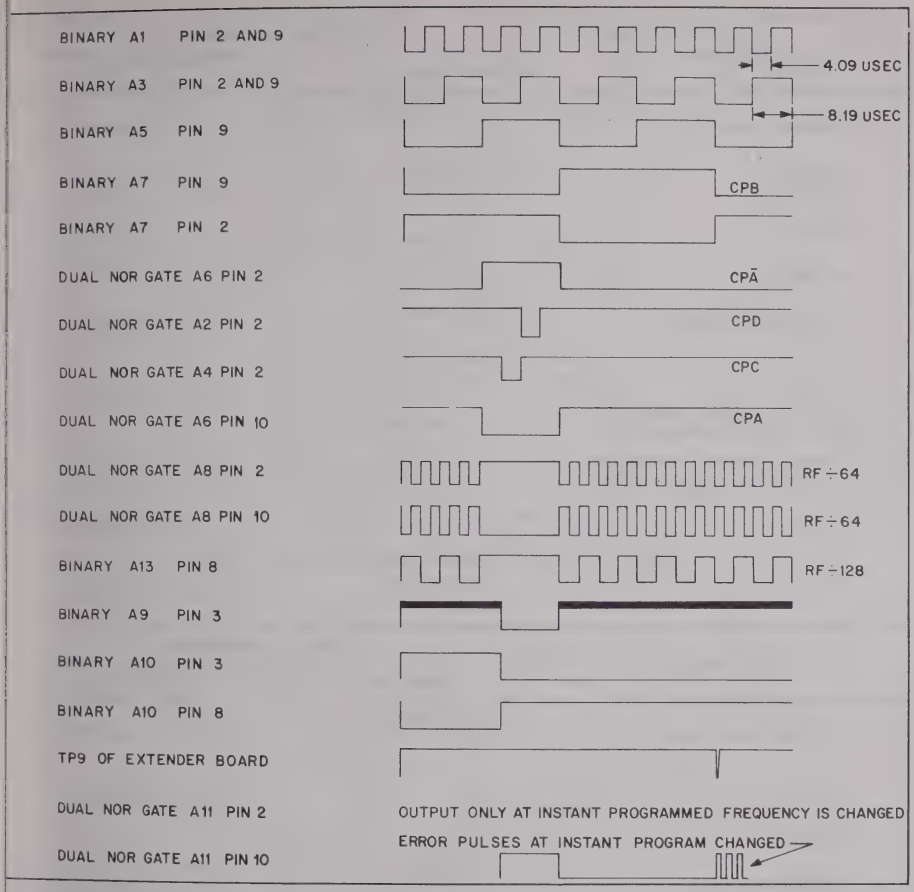


Figure 4-197 (9). Synthesizer waveforms (part 9 of 16).

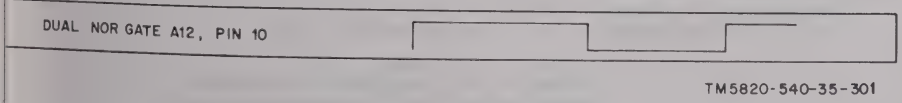


Figure 4-197 (10). Synthesizer waveforms (part 10 of 16).

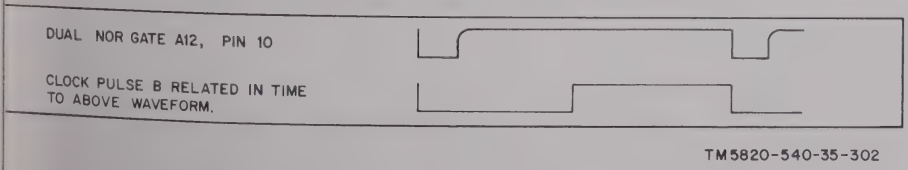


Figure 4-197 (11). Synthesizer waveforms (part 11 of 16).

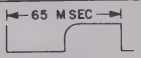
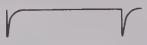
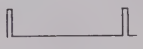
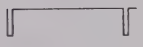
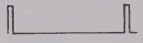
TEST POINT	TYPICAL INDICATION	
	DISPLAY	AMPLITUDE PEAK-TO-PEAK
TP6 (EXTENDER BOARD)	←65 MSEC→ 	4 VOLTS
Q3 BASE		4 VOLTS
Q4 BASE		1 VOLTS
Q5 BASE		2 VOLTS
TP2 (CIRCUIT BOARD)		8 VOLTS
	VOLTAGE	
TP3 (+) OF CIRCUIT BOARD AND TP3 (-) OF EXTENDER BOARD	9.2 VOLTS DC	
TP4 (+) OF CIRCUIT BOARD AND TP3 (-) OF EXTENDER BOARD	0 VOLTS	

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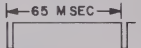
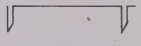
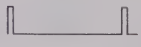
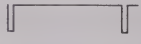
Figure 4-197 (12). Synthesizer waveforms (part 12 of 16).

TEST POINT	TYPICAL INDICATION	
	DISPLAY	AMPLITUDE PEAK-TO-PEAK
TP7 (EXTENDER BOARD)	←65 MSEC→ 	4 VOLTS
Q1 BASE		4 VOLTS
Q2 BASE		2 VOLTS
TP1 (CIRCUIT BOARD)		10 VOLTS
	VOLTAGE	
TP3 (+) OF CIRCUIT BOARD AND TP3 (-) OF EXTENDER BOARD	1.73 VOLTS DC	
TP4 (+) OF CIRCUIT BOARD AND TP3 (-) OF EXTENDER BOARD	11.1 VOLTS DC	

NOTE
VOLTAGE AT TP4 VARIES FROM APPROXIMATELY 2 VOLTS DC AT 47.5 MHz TO APPROXIMATELY 9 VOLTS DC AT 72.5 MHz.

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Figure 4-197 (13). Synthesizer waveforms (part 13 of 16).

TEST POINT	TYPICAL INDICATION	
	DISPLAY	AMPLITUDE PEAK-TO-PEAK
BINARY A1, PIN 10	2 USEC	4 VOLTS
BINARY A1, PIN 8	4 USEC	4 VOLTS
BINARY A2, PIN 8	8 USEC	4 VOLTS
BINARY A3, PIN 8	16USEC	4 VOLTS
BINARY A4, PIN 8	32 USEC	4 VOLTS
BINARY A5, PIN 8	64 USEC	4 VOLTS
BINARY A6, PIN 8	128USEC	4 VOLTS
BINARY A7, PIN 8	256uSEC	4 VOLTS
BINARY A8, PIN 8	512USEC	4 VOLTS
BINARY A9, PIN 8	10.24MSEC	4 VOLTS
BINARY A10, PIN 8	20.48 M SEC	4 VOLTS
BINARY A11, PIN 8	40.96 MSEC	4 VOLTS
TP2 OF EXTENDER BOARD	40.96 MSEC	9 VOLTS

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Figure 4-197 (14). Synthesizer waveforms (part 14 of 16).

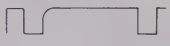
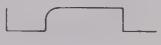
TEST POINT	TYPICAL INDICATION	
	VOLTAGE	AMPLITUDE PEAK-TO-PEAK
TP5(+) AND TP1(-) OF CIRCUIT BOARD	25 VOLTS DC	
Q5 BASE	12.6 VOLTS DC	
Q5 EMITTER	11.9 VOLTS DC	
Q5 COLLECTOR	12.1 VOLTS DC	
Q4 COLLECTOR	15.8 VOLTS DC	
	DISPLAY	
BINARY A4, PIN 8		4 VOLTS
GATE A2, PIN 3		4 VOLTS
GATE A2, PIN 2		4 VOLTS
BINARY A3, PIN 8		4 VOLTS
GATE A5, PIN 4		4 VOLTS
GATE A3, PIN 2		4 VOLTS

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Figure 4-197 (15). Synthesizer waveforms (part 15 of 16).

TEST POINT	TYPICAL INDICATION	
	VOLTAGE	AMPLITUDE PEAK-TO-PEAK
TP5(+) AND TP1(-) OF CIRCUIT BOARD	0.5 VOLTS DC	
Q5 BASE	11.7 VOLTS DC	
Q5 EMITTER	11.9 VOLTS DC	
Q5 COLLECTOR	12.7 VOLTS DC	
Q4 COLLECTOR	12 VOLTS DC	
	DISPLAY	
BINARY A1, PIN 10	1 USEC	4 VOLTS
BINARY A1, PIN 8		4 VOLTS
BINARY A1, PIN 3		4 VOLTS
GATE A2, PIN 10		4 VOLTS
GATE A2, PIN 3		4 VOLTS
GATE A3, PIN 8		4 VOLTS
GATE A5, PIN 2		4 VOLTS

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Figure 4-197 (16). Synthesizer waveforms (part 16 of 16).

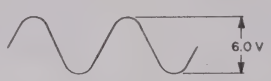
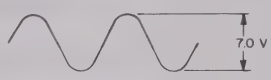
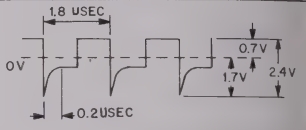
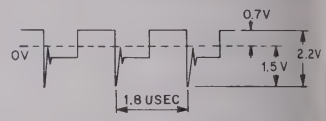
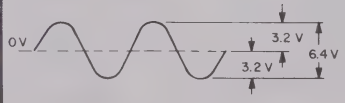
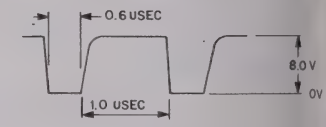
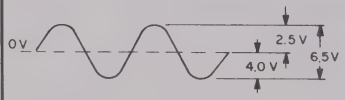
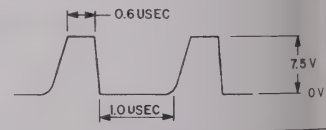
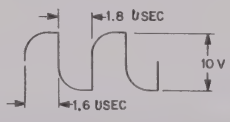
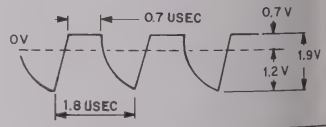
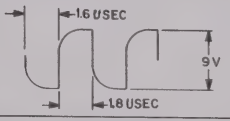
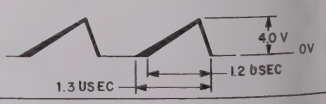
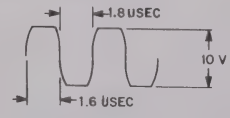
TEST POINTS	INDICATION	TEST POINTS	INDICATION
E2		Q5 BASE	
Q1 COLLECTOR		Q6 BASE	
Q2 EMITTER		Q7 BASE	
CR1 CATHODE CR2 ANODE	+2.5 V DC −2.5 V DC	Q8 BASE	
Q3 BASE		Q7 COLLECTOR	
Q3 EMITTER		Q8 COLLECTOR	
E5 OR Q4 COLLECTOR		Q9 BASE	
E6 OR Q5 COLLECTOR		TP1	
Q4 AND Q5 EMITTER			

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Figure 4-198. Electrical synthesizer 1RE1A3A3, typical waveforms.

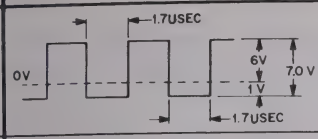
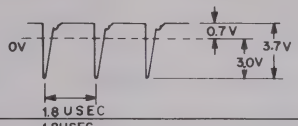
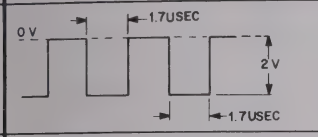
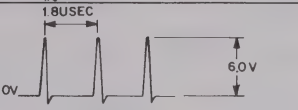
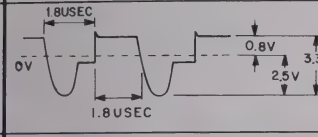
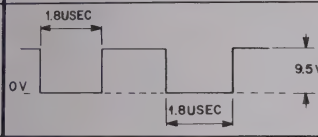
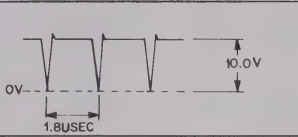
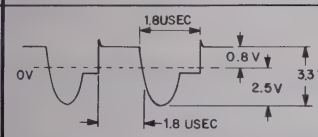
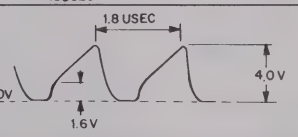
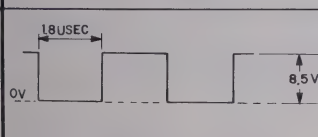
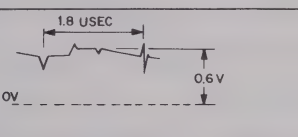
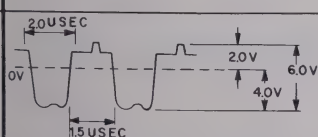
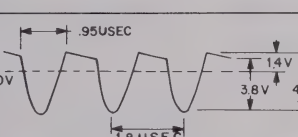
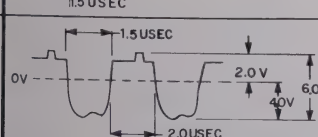
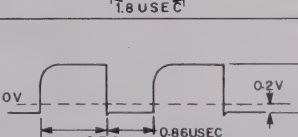
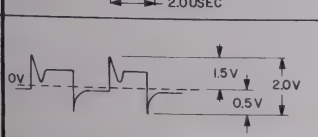
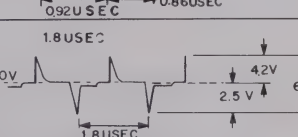
INDICATION	TEST POINTS	INDICATION
	Q7 BASE	
	Q7 COLLECTOR	
	Q6 BASE	
	Q6 COLLECTOR	
	Q8 COLLECTOR	
	Q8 BASE	
	CR4 ANODE	
	Q9 COLLECTOR	
	E8	

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Figure 4-199. Pulse form restorer 1RE1A3A2, typical waveforms.

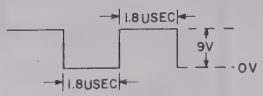
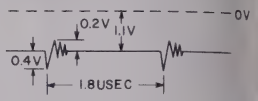
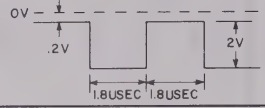
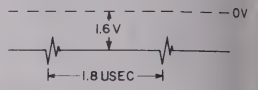
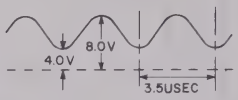
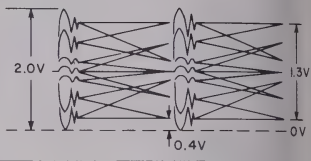
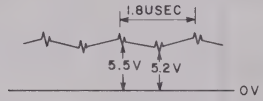
TEST POINTS	INDICATION	TEST POINTS	INDICATION
E2		Q3 BASE	
TP2		Q4 BASE	
E3		PCM CANCEL AND OW GAIN CONTROLS	
Q2 BASE		TP3 (WITH OW)	
TP1		E10 (AT 1000 CPS)	

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Figure 4-200. Modulation eliminator 1RE1A3A1, typical waveforms.

Section V. MODULE TEST AND ALIGNMENT PROCEDURES, BAND II RF HEADS

General

his section covers depot maintenance plifier-Frequency Multiplier AM–4321/ 03(V) (band II transmitter RF head) nplifier-Converter AM–4317/GRC–103(V) I receiver RF head). Repair and overhaul l II RF heads mechanical assemblies is in chapter 5. This section lists the tools equipment required to test and repair the transmitter and receiver RF heads. It also all tests and alignments performed at and unit level for Radio Set AN/ 03(V)2, and at module level for band II ds only.

e following test procedures are based on of Test Facilities Set AN/GRM–95(V)1. adapters, filters and similar accessories required for tests but are not listed in the iate *Test Equipment and Material* d paragraph are part of Test Facilities /GRM–95(V)1.

Additional Test Equipment and Material Required

llowing chart lists the test equipment, connectors and special tools required for ot maintenance of band II RF heads in n to the list contained in paragraph 4–2.

NOTE

bles, connectors and other accessories luded in the test facility are not listed this paragraph.

st *Equipment.*

Equipment	Common name
r, Signal SG–)/U.	Signal generator No. 1.
r, Signal SG– G.	Signal generator No. 2
r, Signal SG–644/U	Signal generator No. 3
r, Sweep SG–888	Sweep generator
r, Thermal Noise 904.	Noise generator
r, Thermal Noise 7/U and Power .	High frequency noise generator.
cy Meter AN/USM–	Frequency meter
enerator, Airborne ments Lab, Model	Power signal source
Power Supply Lambda LK–342FM.	Variable power supply
Power Supply Lambda LP–412FM.	Variable power supply
Voltmeter, Electronic ME–247/U.	RF voltmeter
Voltmeter, Vector Hewlett-Packard 8405A.	Vector voltmeter
Accessory Kit, Vector Voltmeter Hewlett-Packard 11570A.	50-ohm loads and 50-ohm T's.
Wave Analyzer Bruel and Kjoer 2107.	Wave analyzer
VSWR Bridge ANZAC RB–3	VSWR bridge RB–3
Resistance Bridge ZM–4/U	Resistance bridge
Test Set, Analyzer Breakdown Voltage AN/GSM–6.	Breakdown voltage tester
Capacitance, Resistance, Inductance Test Set AN/URM–90.	R–L–C bridge
Detector, RF XD–23A	Detector XD–23A
Trombone Line General Radio 874–LTL.	Trombone line 874–LTL
Circulator Melab HD–1–450	Circulator
Power Supply Test Jig SAC–SK–005.	Test jig
Shorting Tool SAC–SK–007	
Unit IF Amplifier, General Radio Model 1216–A.	Unit IF amplifier
Dummy Plate SAC–SK–008	
WidebandRF Amplifier SAC–SK–012.	Wideband RF amplifier
Filter Shield Assembly, SAC–SK–024.	Filter shield assembly
Band II Receiver Multiplier Tuning Law Test Jig SM–D–696026.	Tuning law test jig
Transmitter Amplifier-Frequency Multiplier Test Jig SAC–SK–023.	
Amplifier, GP LA–2300–43	Low noise IF amplifier
Low Pass Filter SM–C–696031	
30-MHz Gaussian Filter SM–A–696149	
Frequency Mixer Stage Test Jig SM–E–696028.	Mixer test jig
Mixer SM–D–696046	
Bandpass Filter Tuning Law Test Jig SM–E–696049	Test jig
Wideband RF Amplifier Test Jig SM–C–696030	
Hybrid Junction, Anzac H–8	
50-ohm Load Omni Spectra 20020P (2 required).	50-ohm load OS20020P
Filter, Low Pass TLC–1000–5EF.	Filter TLC–1000–5EF
Filter, Low Pass TLC–705–8EF (2 required).	Filter TLC–705–8EF

Equipment	Common name
Filter, Low Pass TLC-290-5EF.	Filter TLC-290-5EF
Tunable Bandpass Filter Telonic TTF-250-5-3EE.	Tunable filter 190-375 MHz.
Tunable Bandpass Filter Telonic TTF-1000-5-3EE.	Tunable filter 750-1500 MHz.
Tunable Bandpass Filter Telonic TTF-1500-5-5EE.	Tunable filter 1000-2000 MHz.
Tektronic Clip Lead, 013-0076-00.	Clip lead
Tunable Bandpass Filter Telonic TTF-500-5-3EE.	Tunable filter 375-750 MHz.
Dummy Load Hewlett-Packard 908A.	Dummy load HP-908A.
Dummy Load Telonic TRM-1-1.60F.	Calibrated mismatch TRM-1-1.60.
Dummy Load Telonic TRM-1-1.30F.	Calibrated mismatch TRM-1-1.30.
Dummy Load Telonic TRM-1-3.50F.	Calibrated mismatch TRM-1-3.50.
Attenuator Variable, Weinschel 905.	Variable attenuator No. 3.
Attenuator, Fixed Weinschel 693-30.	20-db, 30-watt attenuator
Attenuator, Fixed, 20 DB, 50W Empire Devices, Inc., Model AT-70.	20-db, 50 watt attenuator
Dummy load, 50Ω, 50W SM-A-697452	
Resistor, Variable 0-1 ohm, 20 watts.	1-ohm variable resistor
Dummy Load, Electrical DA-437/GRC-103(V).	
Resistor, Variable 0-12 ohms, 50 watts.	12-ohm variable resistor
Dummy Load, Electrical DA-535/U.	
Resistor, Fixed 10k ohms, ½ watt.	10k-ohm fixed resistor
Generator, Thermal Noise SG-419/U.	Low frequency noise generator.

b. Connectors.

Equipment	Common name
Adapter-Connector UG-57B/U.	
Adapter-Connector UG-107B/U.	
Adapter-Connector Hewlett-Packard 11536A.	Adapter-connector HP11536A.
Adapter-Connector UG-564A/U.	
Adapter-Connector Omni Spectra 21010.	Adapter-connector OS21010
Adapter-Connector Omni Spectra 21200.	Adapter-connector OS21200
Adapter-Connector Omni Spectra 21190 (2 required).	Adapter-connector OS21190
Adapter-Connector Omni Spectra 21030 (2 required).	Adapter-connector OS210[illegible]0

Equipment	Common name
Adapter-Connector Omni Spectra 21020 (2 required).	Adapter-connector O[illegible]020
Adapter-Connector Omni Spectra 21170.	Adapter-connector O[illegible]1170
Adapter-Connector Omni Spectra 217.	Adapter-connector O[illegible]17
Adapter-Connector Omni Spectra 21180.	Adapter-connector O[illegible]1180
Adapter-Connector 874-QNJA (2 required).	
Adapter-Connector 874-QNJL (2 required).	
Adapter-Connector 874-QBJL (3 required).	
Adapter-Connector 874-QBPA.	
Adapter-Connector 874-QBJA.	
Adapter-Connector Mi-Kro Grip P-5012.	

c. Special Purpose Cables.

Cable Assembly, Special Purpose, Electrical SAC-SK-001.
Lead Test SAC-SK-002.
Cable Assembly, Special Purpose, Electrical SAC-SK-003.
Cable Assembly, Special Purpose, Electrical SAC-SK-004.
Cable Assembly, Special Purpose, Electrical SA-SK-009.
Cable Assembly, Special Purpose, Electrical SAC-SK-014.
Cable Assembly, Special Purpose, Electrical SAC-SK-105.
Cable Assembly, Special Purpose, Electrical SAC-SK-025.
[1]Cable Assembly, Special Purpose, Electrical CX-10762/GRC-103(V) (2 required).
[1]Cable Assembly, Special Purpose, Electrical Branched CX-10763/GRC-103(V).
[1]Cable Assembly, RF CG-3444/U (1 ft 6 in.

[1] These items are part of Radio Set AN/GRC-103(V)2. [illegible]y may or may not be available at this level for maintenance use.

d. Special Tools.

Clamp 702-800013
Wrench, Torque 2 lb-in.
Drift Pin Punch

NOTE

VSWR Detector TRB-3 and calibrat[illegible] mismatches—
TRM-1-1.00F
TRM-1-1.20F

M–1–1.25F
M–1–1.40F
M–1–1.50F
M–1–1.75F
M–1–2.00F
M–1–2.50F
part of Test Facilities Set AN/
M–95(V)1.

Use of Test Facilities Set AN/GRM–95(V)1—Band II Maintenance

aintenance procedures for band II RF
e based on the use of the Test Facilities
GRM–95(V)1 where possible. In conjunc-
h additional test equipment and/or test
test facility provides, in certain cases

necessary operating power to individual

rnal signal sources.

c. Detection, measurement, and internal calibration facilities.

d. Cables, connectors, filters, attenuators, and other equipment used in test procedures.

4–109. Amplifier-Frequency Multiplier AM–4321/GRC–103(V) (Band II Transmitter RF Head)

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Frequency Meter AN/USM–159.	Frequency meter
Wattmeter AN/URM–120	Wattmeter
Wattmeter AN/URM–98	Power meter

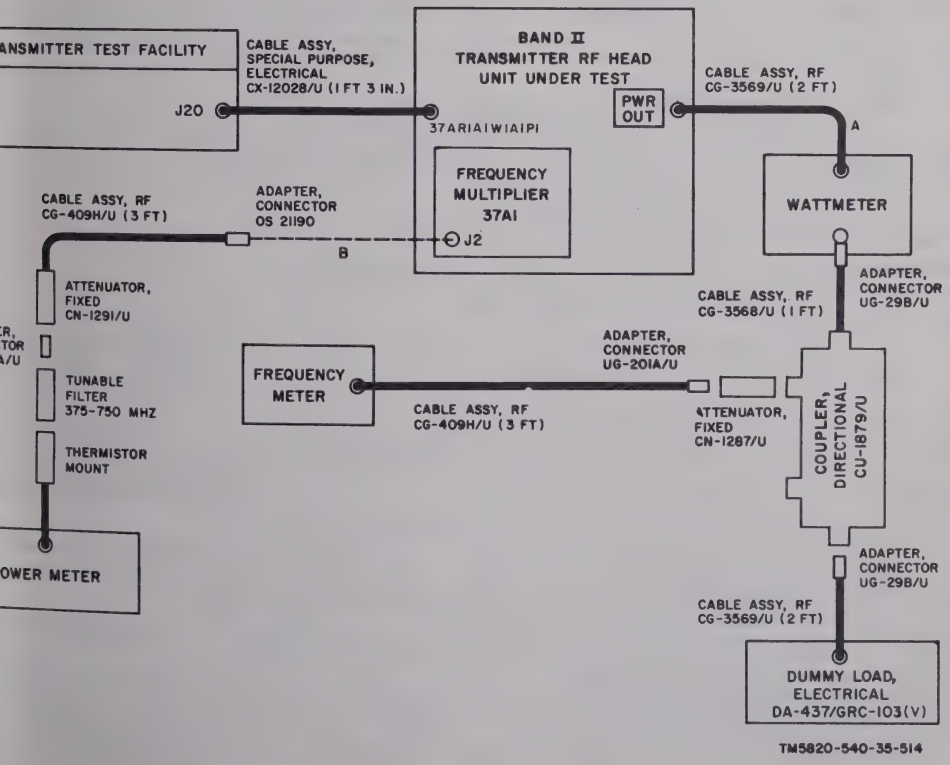


Figure 4–198. Transmitter RF head 37, test setup.

Equipment	Common name
Voltmeter, Digital AN/GSM–64.	Digital voltmeter
Adapter-Connector Omni Spectra 21190.	Adapter-connector OS21190
Tunable Band Pass Filter, Telonic TTF 500–5–3EE.	Tunable Filter 375–750 MHz.
Oscilloscope AN/USM–281	Oscilloscope
Multimeter TS–352/U	Multimeter

b. Test Procedure.

(1) *Preliminary setup.*

(*a*) Connect the test equipment as shown in A, figure 3–198.

(*b*) Direct cooling air from the AIR OUTLET of the transmitter test facility to the rear of the unit under test.

(*c*) Set the XMTR TUNE and XMTR CHANNEL controls on the unit under test to channel 1010.

(*d*) Set the test facility switches as follows:

Switch	Switch position	Normal indications
S1	ON	
S20	S12	
S12	OSC	Test facility meter M1 indicates between 20% and 90% of full scale, LOW PWR lamp on test facility should light.
S13	ON	

(*e*) Adjust the VOLTAGE control on the accessory kit power supply for 115v ac on the VOLTS meter.

(*f*) Turn test facility switch S12 to the following positions:

Switch position	Normal indications
DBLR	M1 indicates between 40% and 60% of full scale.
MULT	M1 indicates between 40% and 60% of full scale.
DRIVER	M1 indicates between 20% and 60% of full scale.

(*g*) Turn test facility switch S12 to PWR OUT and adjust the XMTR TUNE and the PWR OUT PEAK controls on the unit under test for maximum indication on meter M1. The LOW POWER lamp on the test facility should go out, the wattmeter should indicate 25 watts minimum and M1 should indicate 40 percent minimum.

(2) *Cathode and heater voltage measurement and alc ripple check.*

(*a*) Check for the following voltages t voltage regulator assembly 37AR1A1A1 (3–44) using the digital voltmeter:

Test points	Voltage (volts dc)
TP2(−) and TP4(+)	6.0 to 6.4
TP1(−) and TP3(+)	6.0 to 6.4
TP9(−) and TP4(+)	19 maximum
TP9(−) and TP8(+)	0.65 to 0.85
TP9(−) and TP7(+)	0.65 to 0.85

(*b*) Alc rippled as measured on the oscil- scope connected to TP5(+) and TP9(—) f 37AR1A1A1 should not exceed 0.5v peak-to-pe

(3) *Power output and tracking check.*

(*a*) Set the XMTR TUNE and XMT CHANNEL controls on the unit under test t channel 390.

(*b*) Adjust the XMTR TUNE and te PWR OUT PEAK controls for maximum indi- tion on the test facility meter M1 with switch S2 at PWR OUT. The power meter should indicate t least 25 watts, the frequency meter should in- cate 395 MHz ± 7.90 kHz and the XMTR TUN channel indication should be within 0.5 inch of te center of the display window.

(*c*) Repeat (*a*) and (*b*) above for the ch- nels listed below.

Channel	Frequency (MHz)	Tolerance (+ kHz)
400	400	8.0
480	440	8.8
560	480	9.6
640	520	10.4
720	560	11.2
759	579.5	11.6
760	580	11.6
800	600	12.0
880	640	12.8
960	680	13.6
1000	700	14.0
1010	705	14.1

d. Tracking Alignment.

(1) Connect the equipment as shown in , figure 4–198.

(2) Set the XMTR TUNE and XMT CHANNEL controls on the unit under test t channel 390 (395 MHz).

(3) Set the test facility switches S1 to O and S12 to OSC.

(4) Set the tunable filter to 395 MHz a peak for maximum indication on the power met The power level at J2 of the frequency multipli should be at least +23 dbm (+2 dbm as indicat on the power meter).

Troubleshooting (fig. 7–1).

NOTE

This chart supplements the troubleshooting procedures contained in TM 11–5820–540–12 and paragraph 3–68.

Symptom	Probable cause	Checks and corrective measures
DRLR meter indication zero in *b* (1)(*f*) above.	+28v interlock open circuit	Check for continuity between 37AR1A1W1A1P1 pins 11 and 12 (fig. 3–44).
MULT meter indication low or zero in *b*(1)(*f*) above.	*a.* Defective frequency multiplier 37A1.	*a.* Check that at least 200 mw (+23 dbm) is present at 37A1J2 (fig. 3–42). If power level at 37A1J2 is abnormal, check that at least 2w (+33 dbm) is present at 37AR1A1W1A1P2. If this is normal, remove 37A1 (para 4–145) and test as described in paragraph 4–110.
	b. Wiring	*b.* If input level to 37A1 is abnormal, check the continuity of cable connected to 37A1J1 (fig. 3–42). If input and output levels at 37A1 are normal, check the metering circuit (fig. 7–2).
DRIVER meter indication low or zero in *b*(1)(*f*) above.	*a.* Open circuit in driver filament line	*a.* Check resistance between 37AR1A1W1J5 (fig. 3–44) pins 11 and 12; it should be 1.5 ohm nominal. Driver tube must be inserted for this check.
	b. Defective cable 37W1 (fig. 3–42)	*b.* Check cable with multimeter and replace if necessary.
	c. Defective cable 37AR1AR1W1 (fig. 3–42).	*c.* Check with ohmmeter and replace if necessary.
	d. Tracking misalignment between 37A1 and 37AR1.	*d.* Check tracking as described in *d* below.
	e. Excessive voltage drop across 37AR1A1FL2 (fig. 3–44).	*e.* Check voltage at E2 of 37AR1A1FL2 which should be not more than 3v lower than voltage at E1 of 37AR1A1FL2 (630v dc nominal).
	f. RF amplifier 37AR1	*f.* Check 37AR1 as described in paragraph 4–112.
	g. Resistor assembly 37AR1A1A2 (fig. 3–42).	*g.* Disconnect wire at E1 of 37AR1A1A2. Resistance between E1 and ground should be 440K ohms.
PWR OUT meter indication zero in *b*(1)(*g*) above. Output power normal as indicated on wattmeter.	Metering circuit	Check metering circuit (fig. 7–2).
PWR OUT meter indication low or zero in *b*(1)(*g*) above. Output power low or zero as indicated on wattmeter.	*a.* Excessive voltage drop across 37AR1A1FL2 (fig. 3–44).	*a.* Check voltage at E2 of 37AR1A1FL2 which should not be more than 3v lower than voltage at E1 of 37AR1A1FL2 (630v dc nominal).
	b. Resistor assembly 37AR1A1A2 (fig. 3–42).	*b.* Disconnect wire at E1 of 37AR1A1A2. Resistance between E1 and ground should be 440K ohms.
	c. High insertion loss in low pass filter 37AR1A1FL1 (fig. 3–44).	*c.* Remove 37AR1A1FL1 and test as described in paragraph 4–114.
Voltage not as specified in *b*(2)(*a*) above.	Defective voltage regulator assembly 37AR1A1A1 (fig. 3–44).	Remove voltage regulator assembly and test as described in paragraph 4–113.
Excessive ripple on alc line in *b*(2)(*b*) above.	Defective voltage regulator 37AR1A1A1 (fig. 3–44).	Remove voltage regulator assembly and test as described in paragraph 4–113.
Incorrect frequencies	Control line(s) open circuit	Check for continuity of control lines between 37AR1A1W1J3 (fig. 3–42) and 37AR1A1W1A1P1 (fig. 3–44).

Symptom	Probable cause	Checks and corrective measures
9. Incorrect frequencies at channel 760 and up, in *b*(3)(*c*) above.	Control line 13 open circuit	Check for continuity between 37AR1A1W1A1P1 (fig. 3–44) pin 45 and 371R1A1W1J3 (fig. 3–42) pin 13 and between 37AR1A1W1J3 pin 13 and 37AR1A1W1J2 (fig. 3–42) pin 9.
10. Wattmeter or power meter indications below normal at some frequencies in *b*(3)(*b*) and (*c*) above.	Misalignment	Perform tracking alignment as d3scribed in *d* below.

(5) If the power level is not as specified, loosen the four mounting screws for control-indicator 37A2 and place the control-indicator by the side of the transmitter RF head. Do not disconnect P1 (37AR1A1W1J3) (fig. 3–42).

(6) Remove frequency multiplier 37A1 (para 4–145) then replace 37A1, leaving the flexible drive shaft disconnected.

(7) Reconnect the equipment as shown in B, figure 4–198.

(8) Turn the flexible shaft manually until the output power from the frequency multiplier reaches a maximum as indicated on the power meter.

(9) Secure the shaft temporarily in this position with adhesive tape. Do not reconnect the flexible shaft to the tuning drive mechanism at this time.

(10) Connect P1 (37A1J2) to 37A1J2 (fig. 3–42) and connect the test equipment as shown in A, figure 4–198.

(11) Set the PWR OUT PEAK control to mid range and adjust the XMTR TUNE control for maximum indication on the power meter.

NOTE

Do not move the XMTR TUNE control after the RF amplifier has been peaked.

(12) Observe the XMTR TUNE display window. If necessary, to position the channel-frequency indicator 37AR1AR1DS1 at the correct channel number, remove the channel-frequency indicator as described in paragraph 4–143.

(13) Turn the flexible shaft on the channel-frequency indicator until channel number 390 is in line with the calibration mark (notch) on the body of the channel-frequency indicator.

(14) Replace the channel-frequency indicator as described in paragraph 4–143.

(15) Reconnect the frequency multiplier flexible shaft to the tuning drive mechanism.

(16) Check that the output power is at least 25 watts at the channels listed in *b* (3) (*c*) above.

(17) If the power level drops, disconnect the frequency multiplier flexible shaft from the tuning drive mechanism and re-peak the frequency multiplier output using the flexible shaft.

(18) Repeat steps (15) and (16) above.

4–110. Frequency Multiplier 37A1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Generator, Sweep SG–888	Sweep generator
Oscilloscope AN/USM–281	Oscilloscope
Generator, Signal SG–340A/G	Signal generator No. 2.
Frequency Meter AN/USM–159.	Frequency meter
Voltmeter, Digital AN/GSM–64.	Digital voltmeter
Generator, Signal SG–409( )/U.	Signal generator No. 1
Tunable Bandpass Filter Telonic TTF–500–5–3EE.	Tunable filter 375 to 750 MHz.
Tunable Bandpass Filter Telonic TTF–1000–5–3EE.	Tunable filter 750 to 1500 MHz.
Wattmeter AN/URM–98	Power meter
Clamp 702–800013	Clamp
Band II and III Transmitter Amplifier Frequency Multiplier Test Jig SAC–SK–023.	Test jig
Trombone Line General Radio 874–LTL.	Trombone line 874–LTL
Multimeter TS–352B/U	Multimeter

Equipment	Common name
pr-Connector Omni	Adapter-connector OS21020
pe ra 21020 (2 required).	
pr-Connector Omni	Adapter-connector OS21190
p tra 21190.	
e r RF XD–23A	Detector XD–23A
pr-Connector 874–	
NA (2 required).	
pr-Connector UG–	
/U.	
r ter, Electronic	RF voltmeter
247/U.	

Test Procedures.

(1) *Preliminary setup.*

(*a*) Connect the test equipment as shown figure 4–199.

(*b*) Turn sweep generator RF attenuators lb and output level control to maximum.

(*c*) Adjust sweep generator controls to dis- a leveled response from 48 to 73 MHz.

(*d*) Connect the power meter to the sweep rator (B, fig. 4–199) and adjust the output for a reading of 0 dbm on the power meter 3 dbm cw).

(*e*) Set the sweep generator frequency to 48 MHz cw.

(*f*) Connect the test equipment as shown in C, figure 4–199.

(*g*) Set the transmitter test facility switch S1 to ON and S12 to OSC and record the power meter indication.

(*h*) Connect the test equipment as shown in D, figure 4–199 and note the power meter indication; subtract this indication from that recorded in step (*g*) above to obtain the coupling factor of the directional coupler at 48 MHz.

(*i*) Repeat steps (*f*) through (*h*) above for 60 and 70 MHz and record the results.

(*j*) Reconnect the power meter to the sweep generator (B, fig. 4–199) and adjust the sweep generator output level for a —3 dbm indication on the power meter.

(*k*) Set the test facility switch S1 to OFF.

(2) *Automatic level control (alc) checks.*

(*a*) Connect the test equipment as shown in figure 4–200. Set the digital voltmeter to the 25v range and the multimeter to 1A DC range.

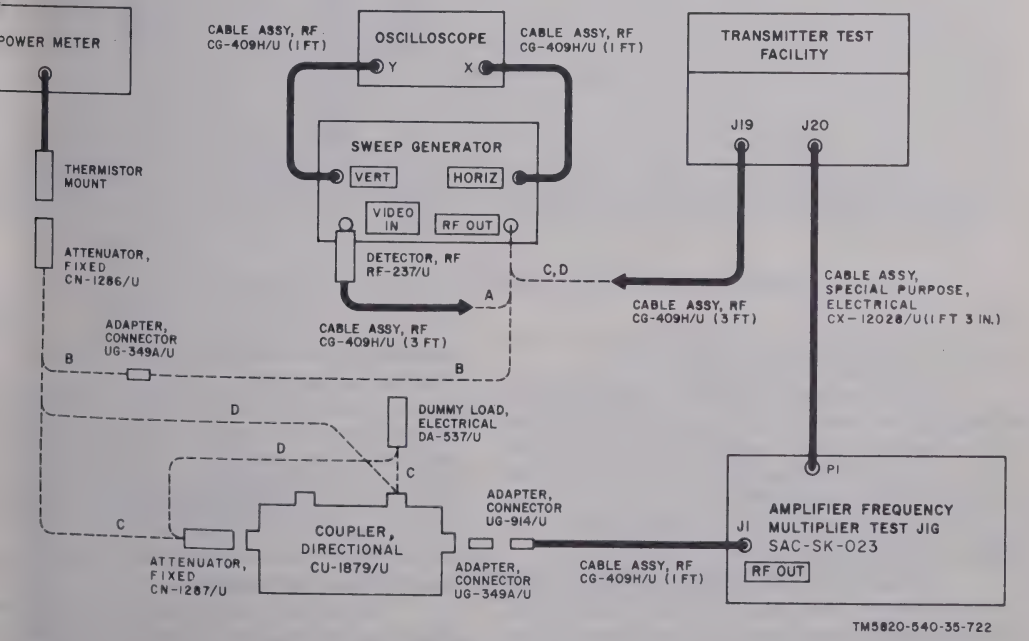


Figure 4–199. Frequency multiplier 37A1, test setup calibration.

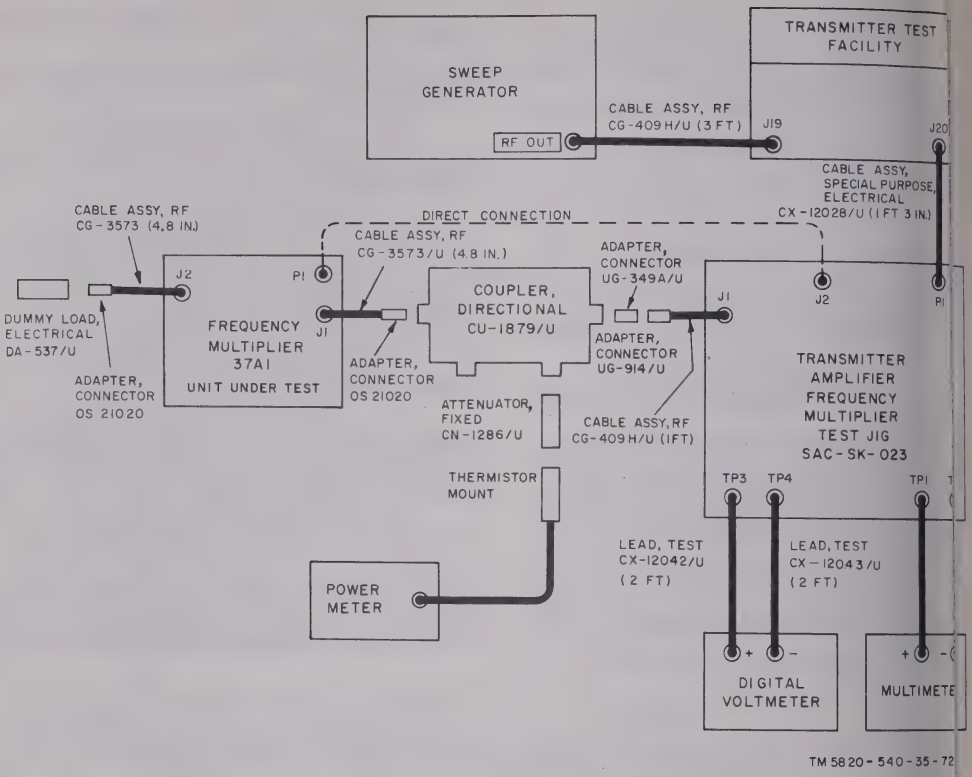


Figure 4–200. Frequency multiplier 37A1 alc checks, test setup.

NOTE

Supply current to unit under test, as monitored by the multimeter, must never exceed 1 amp.

(*b*) Tune the sweep generator output frequency to 60 MHz cw.

(*c*) Set test jig switch S3 to ALC ON and the test facility switch S1 to ON.

(*d*) On the unit under test, adjust R3 (fig. 4–201) for a power level of +33 dbm into the unit under test (power meter indication of +33 dbm minus the coupling factor for 60 MHz noted in (1)(*i*) above, minus 10 db).

(*e*) Set the test jig switches S3 to ALC OFF and S2 to ALC 1.

(*f*) Adjust the output level of the sweep generator for +31.5 dbm into unit under test (power meter indication of +31.5 dbm minus the coupling factor for 60 MHz minus 10 db). The digital voltmeter should indicate 8.0v dc or less.

(*g*) Repeat step (*f*) for a power meter indication of +34 dbm minus the coupling factor minus 10 db. The digital voltmeter should indicate not less than 9.0v dc.

(3) *Output power and tracking checks.*

(*a*) Remove capacitor C1 cover plate (fig. 4–201) and turn the tuning shaft until capacitor C1 is set for minimum capacitance (fully open). Replace the cover plate and do not change the tuning shaft position.

(*b*) Install the unit under test on the test jig and secure it in position with the tuning shaft engaged to the mechanical counter. Connect the test equipment as shown in A, figure 4–202.

(*c*) Set the test jig switch S1 to X6 and the ALC control fully counterclockwise.

(*d*) Set the sweep generator controls to sweep from 47 to 73 MHz.

(*e*) Adjust signal generator No. 2 output frequency to 705 MHz ± 125 kHz as indicated on the frequency meter. Connect signal generator No. 2 to the directional coupler (fig. 4–200

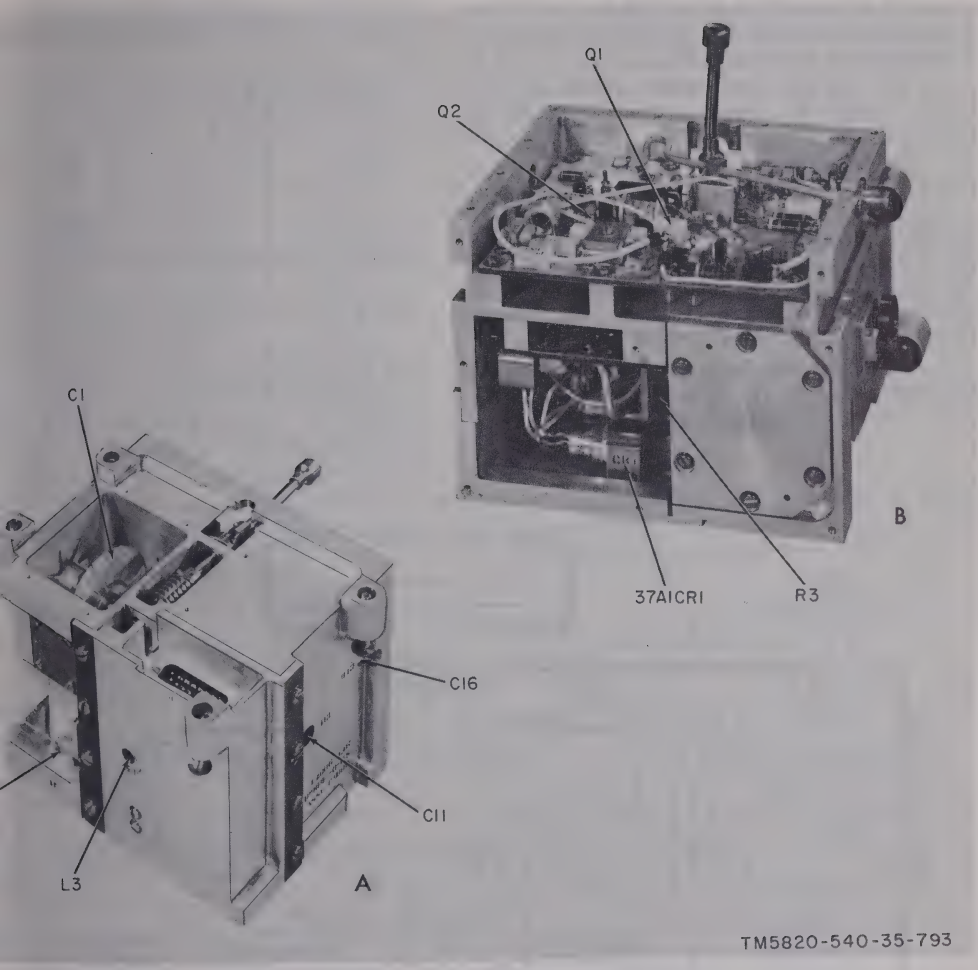


Figure 4-201. Frequency multiplier 37A1, top and bottom view.

(*f*) Turn the mechanical counter control to maximum amplitude response centered on Hz. Set the mechanical counter to indicate

(*g*) Set the sweep generator function to CW and adjust the frequency to center sponse on the 705 MHz marker.

(*h*) Connect the trombone line and power to J2 of the unit under test as shown in C, 4-202.

(*i*) Adjust the trombone line for minimum tion on the power meter. The power meter indicate no less than —1.5 dbm.

(*j*) Set the test jig switch S2 to ALC 2 and adjust the ALC control for a —6.5 dbm indication on the power meter. The digital voltmeter should indicate not more than +6.5v dc. Reset S2 to ALC1 and ALC control fully counterclockwise.

(*k*) Repeat steps (*g*) through (*j*) above for the frequencies marked with an asterisk in the table below. Set test jig switch S1 and counter as indicated. Use signal generator No. 1 for frequencies below 420 MHz.

(*l*) With the unit under test peaked at 395 MHz, adjust the ALC control on the test jig to reduce the power output of the unit under test to

±22 dbm (power meter indication of —1.5 dbm).

(*m*) Reconnect the directional coupler to J2 as shown in A, figure 4–202.

(*n*) Set the test facility switch S12 to DBLR. Meter M1 should indicate between 45 percent and 55 percent.

(*o*) Set the sweep generator function switch to SWEEP and adjust the sweep width controls for a suitable display while maintaining the 395 MHz marker at the center of the display. Mark the peak response on the oscilloscope graticule as the minimum power output.

(*p*) Repeat steps (*c*) and (*f*) above.

(*q*) Tune the sweep generator and signal generator No. 2 to the frequency shown in the table below and set test jig switch S1 and mechanical counter as indicated. Check that the response is centered on the respective output frequencies.

Sweep generator freq. (MHz)	Signal generator No. 2 freq. (MHz)	Switch S1 pos.	Counter reading
58.75	*705	X6	400
58.33	700	X6	151
56.67	680	X6	72
55.00	*660	X6	33
53.33	640	X6	02
51.67	620	X6	69
50.00	600	X6	32
48.33	*580	X6	06
72.50	*580	X4	06
70.00	560	X4	96
67.50	540	X4	90
65.00	520	X4	75
62.50	*500	X4	80
60.00	480	X4	04

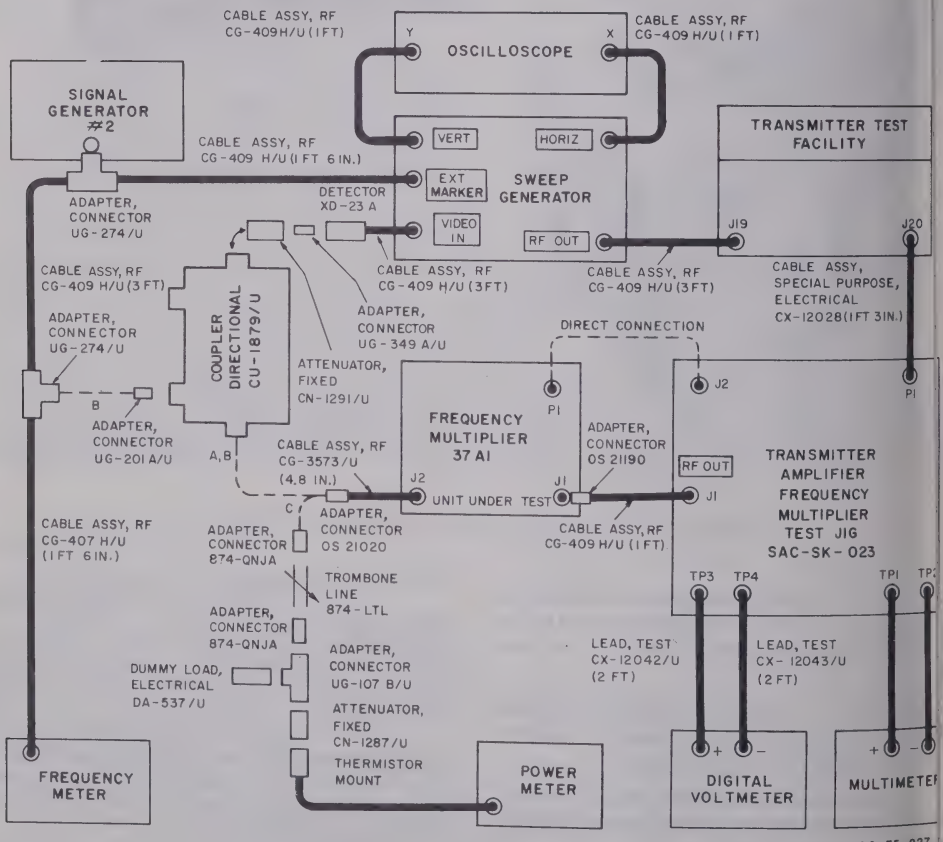


Figure 4–202. Frequency multiplier 37A1 power output and tracking checks, test setup.

ator freq. (z)	Signal generator No. 2 freq. (MHz)	Switch S1 pos.	Counter reading
0	460	X4	10.28
0	440	X4	11.60
0	420	X4	13.40
0	400	X4	14.90
7	*395	X4	15.45

Bandwidth.

a) Connect the test equipment as shown 4–203.

b) Set signal generator No. 1 to 58.5 MHz tput level of 12.5 dbm.

c) Rotate capacitor C1 on unit under test test jig mechanical counter reads 0000.

d) Adjust signal generator No. 1 fre- o obtain a 705 MHz ± 125 kHz indication frequency meter (signal generator No. 1 s 58.75 MHz).

e) Note the unit under test output power d on the power meter.

(*f*) Rotate the signal generator frequency control clockwise until the output power drops by 3 db. The difference between the frequency indicated on the frequency meter and that set in step (*d*) above, should be 4 MHz ± 2 MHz.

(*g*) Return signal generator No. 1 to the 705 MHz indication on the frequency meter ((*d*) above).

(*h*) Rotate the signal generator frequency control counterclockwise until the output power drops by 3 db. The difference between the frequency indicated on the frequency meter and that set in step (*d*) above, should be 4 MHz ± 2 MHz.

(*i*) Repeat steps (*c*) through (*h*) above for all frequencies and counter settings marked with asterisks in table (3) above.

(5) *Rejection check.*

(*a*) Connect the test equipment as shown in figure 4–204, with tunable bandpass filter TTF–500–5–3EE in circuit.

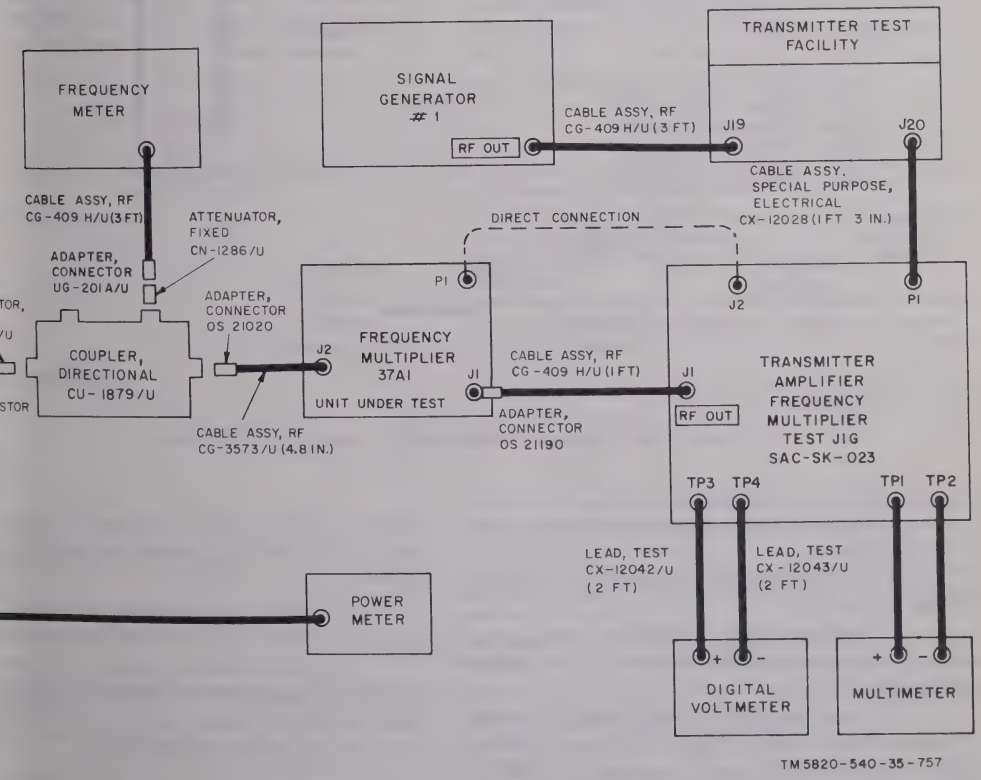


Figure 4–203. Frequency multiplier 37A1 bandwidth check, test setup.

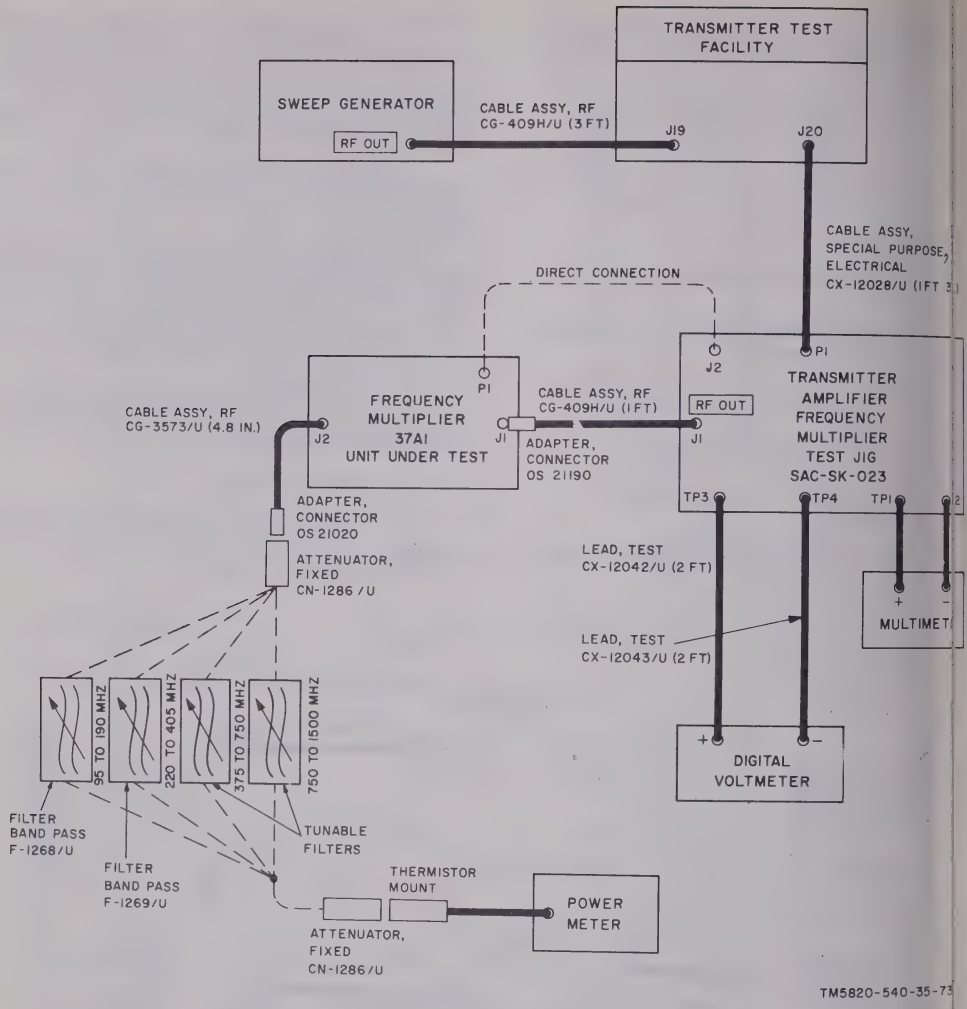


Figure 4–204. Frequency multiplier 37A1 rejection check, test setup.

(*b*) Adjust the sweep generator frequency to 58.75 MHz cw.

(*c*) Set the test jig mechanical counter to 0000 and S1 to X6.

(*d*) Tune the filter to 705 MHz (unit under test output frequency) and note the power meter indication.

(*e*) Tune the filter to the harmonics shown in the table below for an output frequency of 705 MHz, insuring that whenever a harmonic is being checked, a bandpass filter whose tuning range includes that harmonic is connected in circuit; refer to figure 4–204. The power meter should indicate at least 10 db below the level noted in (*d*) above.

(*f*) Repeat (*b*) through (*e*) above for the remaining output frequencies listed in the table.

(*g*) Turn the test jig mechanical counter to 0000. Use clamp 702–800013 and lock the tuning shaft of the unit under test in place. Remove the unit under test from the test jig.

c. Alignment.

(1) Repeat *b* (3) (*a*) through (*f*).

Sig. gen. freq. (MHz)	S1 pos.	Harmonics of Input (MHz)									
		2	4	6	8	10	12	14	16	18	20
705	X6	117.5	235.0	352.5	470.0	587.5	----	822.5	940.0	1057.5	
660	X6	110.0	220.0	330.0	440.0	550.0	----	770.0	880.0	990.0	
580	X6	96.66	193.5	290.0	381.0	484.0	----	676.0	772.0	868.0	966.6
580	X4	145.0	290.0	435.0	----	726.0	870.0	1015.0			
500	X4	125.0	250.0	375.0	----	625.0	750.0	875.0	1000.0		
395	X4	98.8	197.6	296.4	----	493.8	593.0	692.0	791.0	890.0	988.0

Adjust C16 (fig. 4–201) for maximum
e amplitude and readjust C1 if necessary
r the response on the 705 MHz marker.

Set test jig switch S1 to X4 and adjust
l mechanical counter reads 8.90.

) Disconnect the frequency meter from the
nal coupler and adjust the signal genera-
quency to 480 MHz ± 125 kHz. Reconnect
quency meter and signal generator to the
nal coupler.

) Adjust C11 and L3 (fig. 4–201) for maxi-
sponse amplitude.

) Set test jig switch S1 to X6 and adjust
il mechanical counter reads 0000. Repeat
) for 705 MHz.

) Repeat *b* (3) (*g*) through (*o*).

(8) Adjust the sweep generator to sweep from 48.3 to 72 MHz and turn the test jig ALC control fully counterclockwise.

(9) Disregard the counter setting and tune the unit under test through the X4 range. The output should not fall below the level marked on the graticule in *b* (3) (*o*). Adjust capacitor C11 (fig. 4–201) if necessary.

(10) Set the test jig switch S1 to X6. Adjust the sweep generator to sweep from 48.3 to 59.0 MHz.

(11) Disregard the counter setting and tune the unit under test through the X6 range. The output should not fall below the level marked on the graticule in *b* (3) (*o*). Adjust C11 and C16 if necessary. If C11 is readjusted, repeat steps (8) and (9) above.

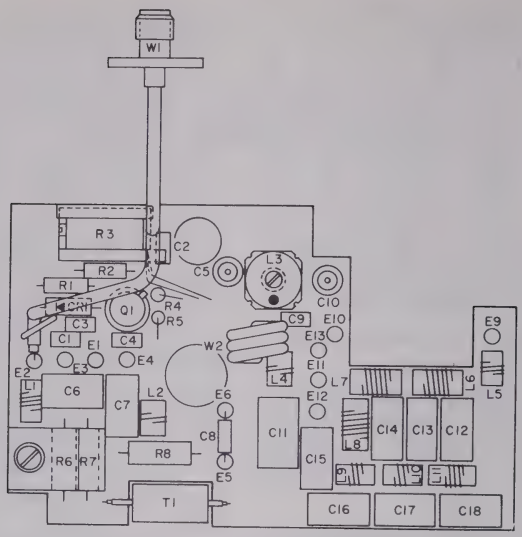
Symptom	Checks and corrective measures
1 requirements not met. (*b*(2)(*f*) and (*g*) above)	Check transistor 37A1A1Q1 (fig. 4–205) and associated components. Replace defective components.
ut low or zero	*a.* Check for damaged cables or connectors and broken wires. Repair or replace as required. *b.* Check for shorted plates on ganged variable capacitor C1 (fig. 4–201). *c.* Check the dc voltages as established in *e* below. Investigate any abnormal indication. Replace components as required. *d.* Check the RF signal at the following points using the allocated voltmeter.

Test point	*Typical indication (volts rms)*
37A1Q2—base	4.5
—collector	30.0

Check components in isolated stage and replace as required.

e. If output is low only at certain frequencies, perform alignment procedures in *c* above.

frequency output abnormal (X6)	Check Q2, CR1, CR6, C16 on circuit card 37A1A2 (fg. 4–205) and associated circuitry of multiplier switching circuit. Replace defective components.
frequency output abnormal (X4)	Check components C17, R10, R11, R12, and L5 of frequency multiplier (37A1A2). Replace defective components.
ttenuation of signal with adjustment of test jig ALC tentiometer.	Check Q1, CR2, CR3, CR4 (37A1A2) and associated ALC components. Replace defective components.
ULT meter indication	Check components in the metering circuit. Replace defective components.
nonic rejection poor	Check transistor 37A1Q1 and components in Q1 collector circuit. Replace defective components.



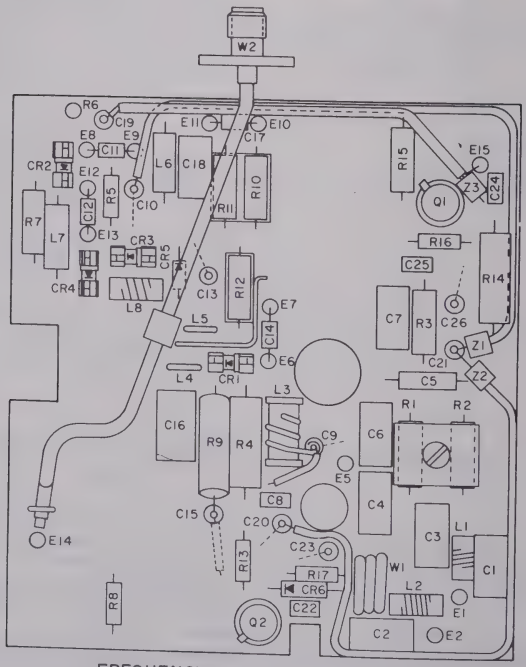


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Figure 4-205. Frequency multiplier 37A1A1 and frequency multiplier 37A1A2, parts location.

) Repeat *b*(4)(*a*) through (*h*) to recheck
r width.

ubleshooting (fig. 7-3).

tage and Resistance Measurements (fig.
)

NOTE

the allocated multimeter for voltage
resistance measurements.

Dc voltage measurements referenced to

Test points	Typical indication (volts dc)
37A1Q1—base	−0.30
—collector	+19.0
37A1Q2—base	−0.1
—collector	+17.5
Test jig switch S1 set to X4	
37A1A2Q2—base	0
—collector	+27.5
Test jig switch S1 set to X6	
37A1A2Q1—base	0
—emitter	0
—collector	+12.8
37A1A2Q2—base	+0.7
—collector	+0.15

nsistor Resistance Measurements.

NOTE

All resistances measured with the allocated multimeter.

Transistor			Base (−)				Base(+)			
			Emitter(+)		Collector(+)		Emitter(−)		Collector(−)	
e	Ref.	Type	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range
	Q1	697-814/1012	54	×1	9500	×100	12.5	×1	750	×100
	Q2	697-814/1852	9.75	×1	9500	×100	9.5	×1	750	×100
	Q1	2N2907	1150	×100	940	×100	1700	×100	31500	×10000
	Q1	2N2222A	>10M	×10000	>10M	×10000	930	×100	930	×100
	Q2	2N2222A	>10M	×10000	>10M	×10000	930	×100	920	×100

Control-Indicator 37A2 or 33A4

st Equipment and Material Required.

Equipment	Common name
lity, Transmitter 66(V)1/GRM-95(V).	Transmitter test facility
r Kit, Test Facilities K-1173(V)1/GRM-	Accessory kit
ickness 0.003 in. sembly, Special e, Electrical K-004.	Feeler gage

st Procedure.

) Connect the test equipment as shown in
1-206.

) Set test facility switches S1 and S6 to

) Turn the tuning control shaft on the unit
test so that the numerical counter indicates
l 390.

NOTE

For control-indicator 33A4 use the first channel number in the (33A4) column in the table below.

(4) Observe the light display on the control-indicator test set. Lamps not illuminated should correspond to Xs in the table below for the channel selected.

NOTE

The tape display on the control-indicator test set applies to Band I equipment only. Disregard tape display and refer to the coding table below.

(5) Repeat steps (3) and (4) above for the remaining channels listed in the table below, in the appropriate column.

(6) Check the stop mechanism by turning control shaft to the limits past channel 300 and channel 1099. At these points, the slipping clutch

Channel No. (37A2)	Lamp display coding													Channel No. (37A4)
	1	2	3	4	5	6	7	8	9	10	11	12	13	
390			X	X		X				X	X		X	350
496									X	X	X		X	396
497		X							X	X	X		X	397
498			X						X	X	X		X	398
499		X	X						X	X	X		X	399
500				X					X	X	X		X	400
501		X		X					X	X	X		X	401
502			X	X					X	X	X		X	402
503		X	X	X					X	X	X		X	403
504					X				X	X	X		X	404
512						X			X	X	X		X	452
520					X	X			X	X	X		X	460
528							X		X	X	X		X	468
536					X		X		X	X	X		X	476
544						X	X		X	X	X		X	484
552					X	X	X		X	X	X		X	492
624												X	X	564
688								X				X	X	628
752									X			X	X	692
759		X	X	X					X			X	X	699
760					X				X			X		700
816								X	X			X		756
880										X		X		720
944								X		X		X		784
1008									X	X		X		748
			X	X				X		X		X		710

should operate to stop further movement of the gears.

CAUTION

Do not exert undue force on the mechanism if the clutch does not slip. Readjust clutch nut as described in paragraph 4–32 *d* (5).

c. Troubleshooting.

Symptom	Checks and corrective measures
One or more lamps, No. 2 thru 12 permanently illuminated.	Remove cover of unit under test. Manually operate switch corresponding to permanently illuminated lamp; this can be done by gently pushing the ball associated with the switch (fig. 4–65). If the lamp does not extinguish while manually operating the switch, replace the faulty switch. Adjust the operating point as described in para 4–32*d*.
One or more lamps, No. 2 thru 12 not illuminated.	If the lamp extinguishes, check that the balls not sticking. Check adjustment of the switch operating point (para 4–32*d* (4)). Check for a sticking ball associated with non-operating lamp. If lamp does not light with switch in released position, replace switch.
Lamp No. 13 permanently on or not illuminating.	Replace command signals decoder (fig. 4–65).

4–112. Radio Frequency Amplifier 37A1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit

Equipment	Common name
AN/URM-98	Power meter
Meter AN/USM-	Frequency meter
TS-352B/U	Multimeter
erator Airborne	Power signal source
nts Labs, Model	
hms 50w. SM-52.	
AN/URM-120	Wattmeter
onnector Omni 21010.	Adapter-connector OS21010
onnector 874-2 required).	
onnector Omni 21170.	Adapter-connector OS21170
onnector Omni 21190.	Adapter-connector OS21190
onnector UG-57B/U	
onnector Omni 21030.	Adapter-connector OS21030
onnector UG-	
dpass TLC-705-required).	Filter TLC-705-8EF
Line General 74-LTL.	Trombone Line 874-LTL
oad, Electrical, /GRC-103(V).	
r Fixed 20 DB 50W Devices, Inc. AT-70.	20-db 50-watt attenuator AT-70.

t Procedures.

Preliminary setup.

WARNING

LETHAL 630V DC present at tube plate radiators.

CAUTION

Do not switch on the power signal source with its output unterminated.

(*a*) Turn power signal source output level control to minimum.

(*b*) Remove the dust cover from the unit under test and connect the test equipment as shown in A, figure 4-207.

(*c*) Direct cooling air from the AIR OUTLET of the transmitter test facility, to the rear of the unit under test.

(*d*) Set the XMTR TUNE control on the unit under test to channel 1010.

(*e*) Switch on the test equipment and set the test facility switches as follows:

(2) *Filament voltage and tube current checks.*

Switch	Position	Normal indication
S1	ON	
S16	OUTPUT NORMAL	
S20	S12	
S12	OSC	Meter M1 should indicate between 20% and 90% of full scale.

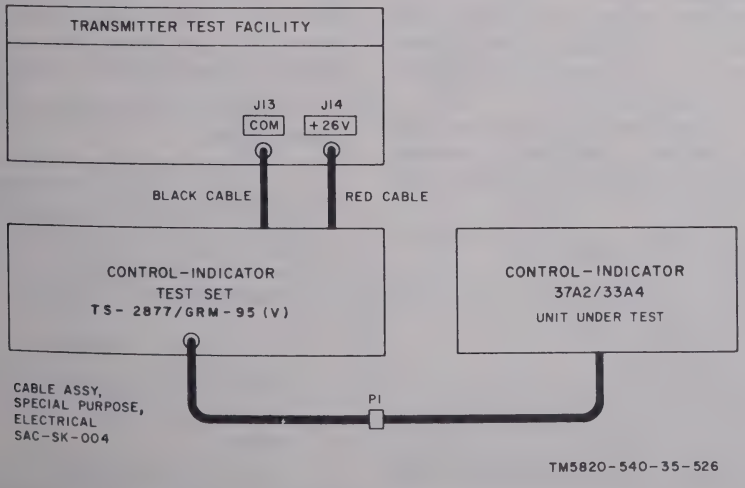

Figure 4-206. Control-indicator 37A2 or 33A4, test setup.

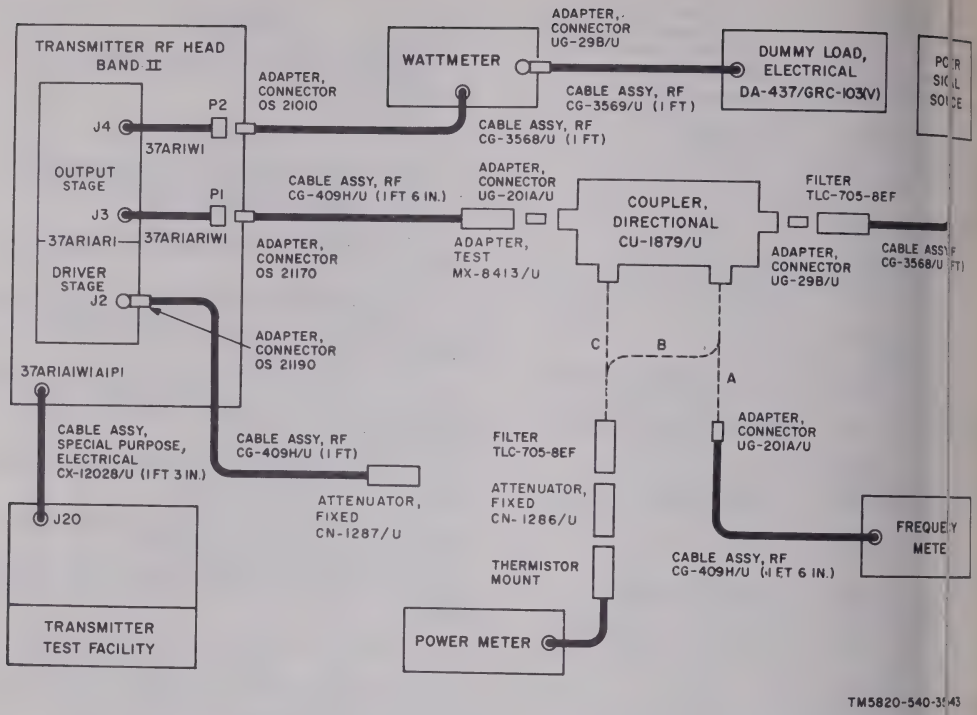

Figure 4-207. Radio frequency amplifier 37AR1, output amplifier check, test setup.

(*a*) Turn the power signal source function switch to CW and tune the frequency control to 705 MHz ± 0.7 MHz as indicated on the frequency meter (A, fig. 4-207).

(*b*) Adjust the output level of the power signal source to ±34 dbm (2.5 watts) (power meter indication of +34 dbm minus coupling factor minus 10 db) (B, fig. 4-207).

(*c*) Use the multimeter to check the voltage on the voltage regulator assembly 37AR1A1A1 (fig. 3-44) at the test points listed below.

Test points		Voltage (v dc)
Neg.	Pos.	
TP2	TP4	5.7 to 6.7
TP1	TP3	5.7 to 6.7
TP9	TP8	0.65 to 0.85
TP9	TP4	13.0 to 15.0

(*d*) Check the voltage between TP4 and TP9 throughout the test and adjust the drive level from the power signal source as required to maintain the voltage at +14v dc ± 1v.

(*e*) Set the test facility switch S12 to ON and S20 to +600V. Meter M1 should indicate within the green band.

(*f*) Set switch S12 to OUTPUT CUR. Meter M1 should indicate within the green band.

(*g*) Set switch S12 to DRIVER CUR. Meter M1 should indicate within the green band.

(3) *Output amplifier power output and input match checks.*

(*a*) Use test setup B, figure 4-207. Adjust simultaneously the PWR OUT PEAK control and the trimmer capacitor 37AR1AR1C11 situated at the rear of the unit (fig. 3-44) for maximum indication on the wattmeter. The level should not be less than 32 watts (+45 dbm).

NOTE

37AR1AR1C11 should only be adjusted by ⅛ turn either side of its normal center.

(*b*) The input level to the output stage shall be less than +36 dbm (power meter indica-

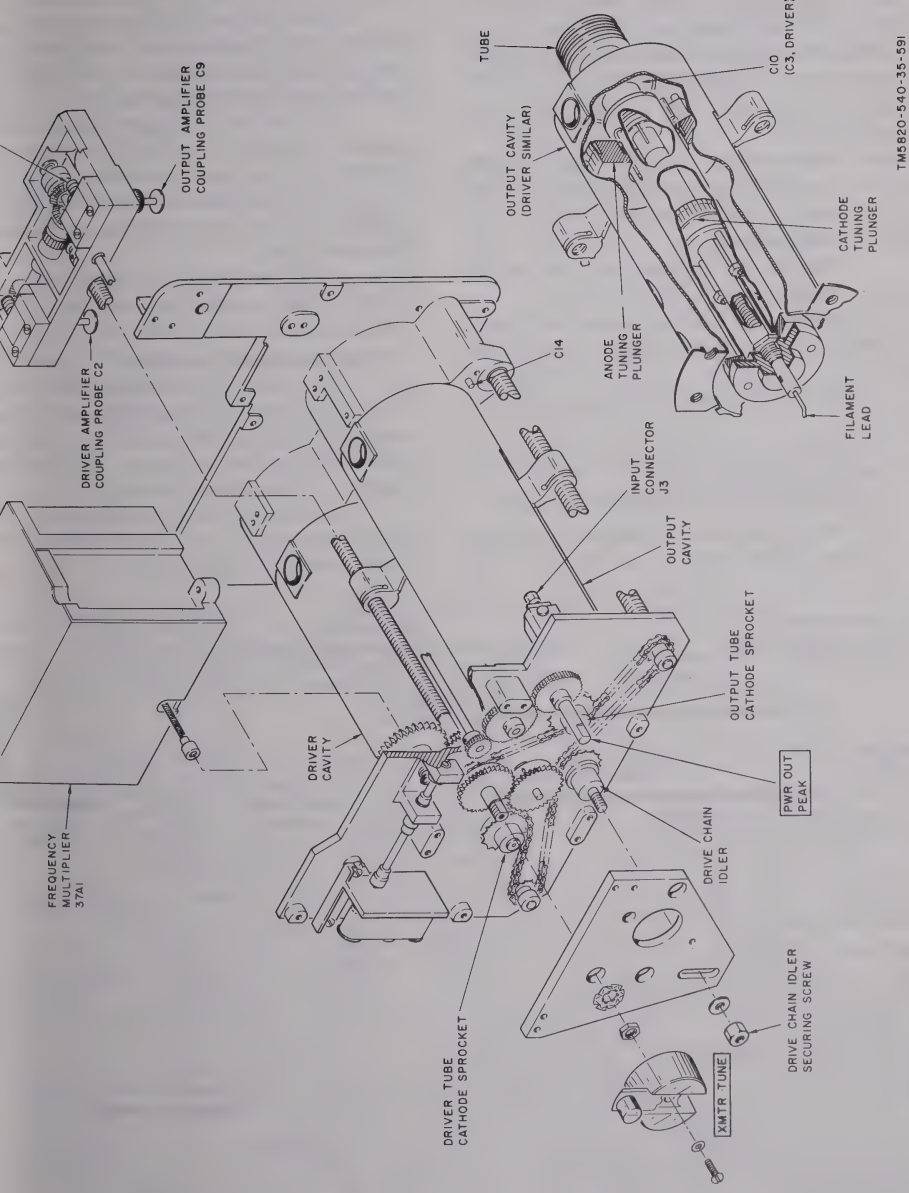

Figure 4-208. Radio frequency amplifier 37AR1 tuning mechanism and cutaway view of resonator.

tion of +36 dbm minus 10 db minus coupling factor), for an indication of +14v dc ± 1v on multimeter. Note the power meter indication in dbm.

(*c*) Connect the power meter to the reflected port of the directional coupler (C, fig. 4–207). The power meter should indicate at least 14 db less than the level recorded in (*b*) above.

(*d*) If the return loss is less than 14 db proceed as follows:

1. Remove the control panel 37MP1 (front panel) of the unit under test (para. 4–142).

2. Loosen the drive chain idler (fig. 4–208) and slacken the chain.

3. Pull the chain free from the output tube cathode sprocket.

4. Rotate the freed sprocket until minimum reflected power is obtained on the power meter.

5. Recheck the cathode voltage as in step (2) (*d*) above.

6. Replace the chain over the sprocket and tighten the drive chain idler.

7. Repeat steps (*a*) through (*c*) above.

(*e*) Reduce the power signal source output level to 100 mw (power meter indication of +20 dbm minus 10 db minus coupling factor (B, fig. 4–207).

(4) *Driver amplifier power output and input match checks.*

(*a*) Connect the test equipment to the driver amplifier as shown in A, figure 4–209. Do not change the position of the XMTR TUNE control (channel 1010 exactly).

(*b*) Adjust the power signal source frequency to 705 MHz ± 700 KHz as indicated on the frequency meter, at an output level of +20 dbm.

(*c*) Set the test facility switch S12 to DRIVER CURR. meter M1 should indicate within the green band.

(*d*) Connect the multimeter positive lead to TP7 and the negative lead to TP9 on the voltage regulator assembly 37AR1A1A1 (fig. 3–44). The multimeter should indicate 0.75v dc ± 0.1v.

(*e*) Adjust simultaneously the driver coupling probe C2 (fig. 4–208) and the trimmer capacitor 37AR1AR1C4 (fig. 3–44) for maximum indication on the wattmeter. The level should be between 3.5 watts and 4.5 watts.

(*f*) Record the level indicated on the power meter connected to the incident port of the directional coupler (B, fig. 4–209).

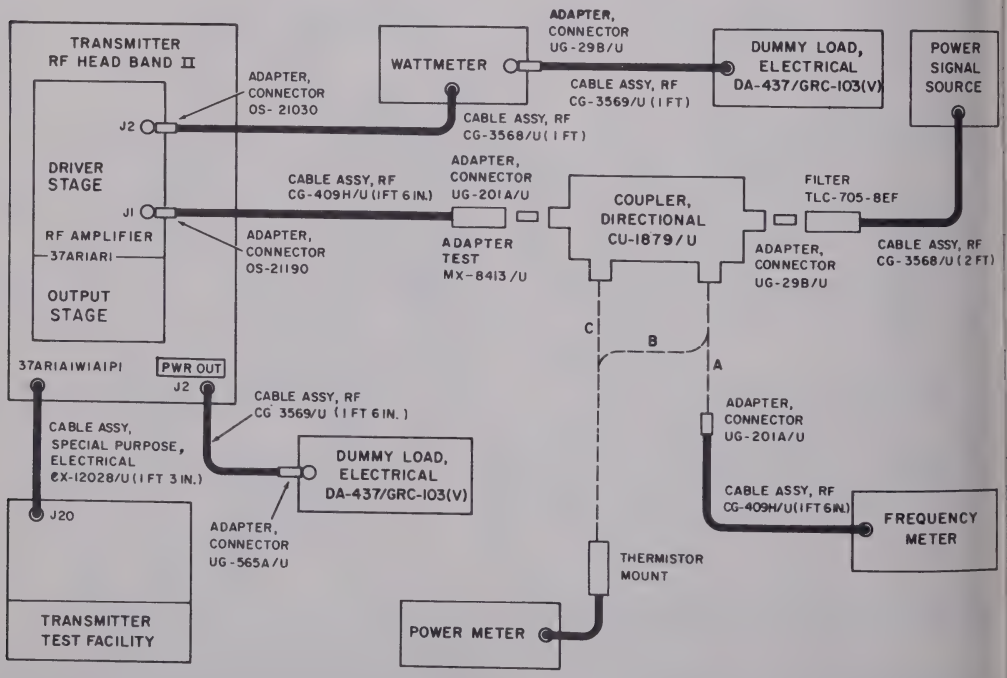

Figure 4–209. Radio frequency amplifier 37AR1, driver amplifier check, test setup.

(*g*) Connect the power meter to the reflected power port (C, fig. 4–209). The power meter should indicate at least 14 db less than the level noted in (*f*) above.

(*h*) If the required level (return loss) in (*g*) above is not obtained proceed as follows:

1. Remove the control panel 37MP1 (front panel) of the unit under test (para 4–142).

2. Loosen the drive chain idler (fig. 4–208) and slacken the chain.

3. Pull the chain free from the driver tube (left hand) cathode sprocket.

4. Rotate the freed sprocket until a minimum reflected power indication is obtained on the power meter.

5. Replace the chain over the sprocket and tighten the drive chain idler.

6. Repeat steps (*f*) and (*g*) above.

(5) *Tuning and power output checks.*

(*a*) Reconnect the signal leads within the amplifier under test to their original positions.

(*b*) Connect the test equipment as shown in A, figure 4–210.

(*c*) Check, and reset if necessary, the frequency from the power signal source. The frequency should be 705 MHz ± 700 kHz.

(*d*) Adjust the output level of the power signal source to +17 dbm (50 mw) (—3 dbm as indicated on the power meter (B, fig. 4–210).

(*e*) Adjust the PWR OUT PEAK and XMTR TUNE controls for maximum output power. If necessary, readjust the power signal source output level to maintain 14v dc ± 1v between TP4 and TP9 of 37AR1A1A1.

(*f*) The output power as indicated on the wattmeter should not be less than 32 watts.

(*g*) Set the test facility switch S12 to PWR OUT. Meter M1 should indicate between 25 percent and 90 percent of full scale.

(*h*) Set S12 to REFL OUT. Meter M1 should indicate less than 20 percent of full scale.

(*i*) Disconnect the wattmeter from the PWR OUT connector. Meter M1 should indicate between 20 percent and 90 percent of full scale.

(*j*) Reconnect the wattmeter to the PWR OUT connector and repeat (*c*) through (*f*) above for the channels listed below. Check that the

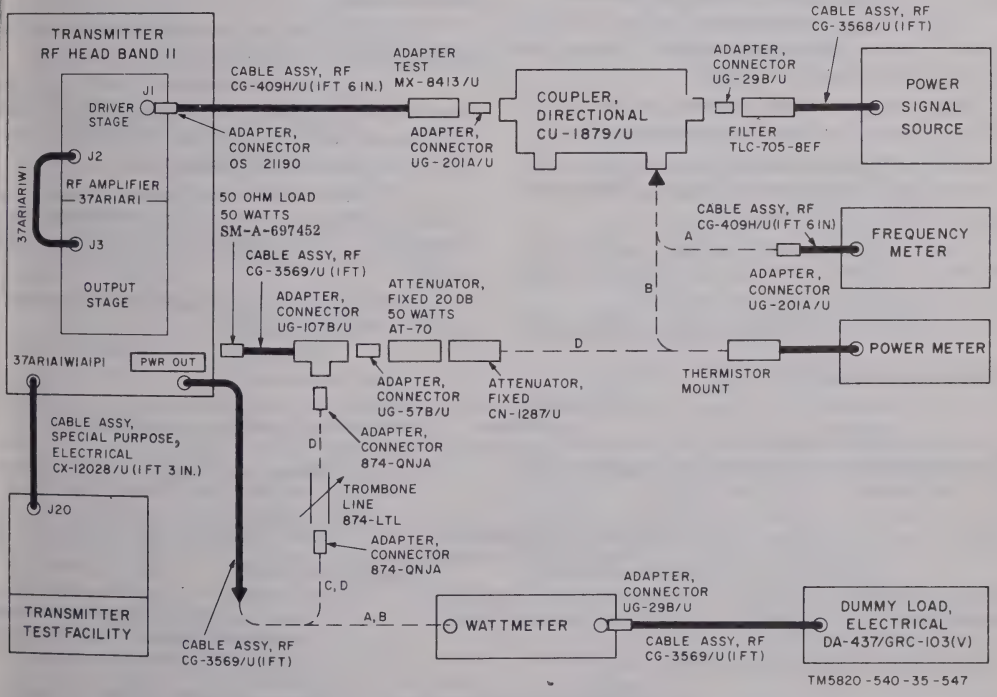

Figure 4–210. Radio frequency amplifier 37AR1, tuning and power output checks, test setup.

required drive level does not exceed +23 dbm (+3 dbm as indicated on the power meter) and that the tape indication is within ± 0.5 inch of the window center.

Channel	Frequency (MHz)	Drive power (14v) (typical mw)	Output power (watts)	
			Min.	Typical
390	395	90	25	37
400	400	100	25	37
480	440	100	25	43
560	480	100	25	35
640	520	110	25	40
720	560	100	25	33
800	600	80	25	38
880	640	70	25	34
960	680	60	25	35
1000	700	60	25	35

(6) *Metering and alc checks.*

(*a*) Set the XMTR TUNE control to channel 1010 and tune power signal source frequency to 705 MHz (A, fig. 4–210).

(*b*) Connect multimeter (set to 50V DC range) to TP4(+) and TP9(—) of voltage regulator assembly 37AR1A1A1.

(*c*) Adjust power signal source output level for +14v dc indicated on the multimeter.

(*d*) Set the test facility switch S12 to DRIVER; meter M1 should indicate between 40 percent and 60 percent full scale.

(*e*) Increase power signal source output level for +15v dc indicated on the multimeter.

(*f*) Connect the multimeter (set to 10 MA DC range) to TP5(+) and TP9(—). Multimeter should indicate no less than 1 ma.

(*g*) Adjust the power signal source output level for an output power of 25w from the unit under test, indicated on the wattmeter.

(*h*) Set the test facility switch S12 to PWR OUT. Meter M1 should indicate between 40 percent and 60 percent full scale. Note M1 indication.

(*i*) Set S12 to REFL OUT. Meter M1 should indicate less than 10 percent of full scale.

(*j*) Disconnect cable from PWR OUT connector of assembly under test. Connect unterminated trombone line to the PWR OUT connector (C, fig. 4–210).

(*k*) Set the test facility switch S12 to PWR OUT. Adjust trombone line for M1 indication noted in (*h*) above.

(*l*) Not used.

(*m*) Set S12 to REFL OUT. Meter M1 should indicate between 67 percent and 87 percent full scale.

(7) *Output vswr check.*

(*a*) Disconnect trombone line and restore test set-up as shown in A, figure 4–210.

(*b*) Repeat (6)(2) through (*e*) above and adjust PWR OUT PEAK, on assembly under test, for maximum output power.

(*c*) Connect power meter and trombone line to the assembly under test as shown in D, figure 4–210.

(*d*) Adjust the trombone line for maximum power meter indication. Note this indication.

(*e*) Adjust the trombone line for minimum power meter indication. The power meter should indicate no more than 1.9 db (2.0:1 vswr) below the value noted in (*d*) above.

(*f*) Repeat steps (*a*) through (*e*) above for channels 720 and 400 with power signal source frequencies of 560 MHz and 400 MHz respectively.

(*g*) Set test facility switch S13 to the off position and S1 to OFF.

c. Troubleshooting (fig. 7–1).

Symptom	Probable cause	Checks and corrective measures
Abnormal indication in *b*(2)(*c*) above	*a.* Defective wiring	*a.* Check the continuity between 37AR1A1-W1A1P1 and 37AR1A1W1J5 (fig. 3–44, 7–2).
	b. Defective voltage regulator assembly 37AR1A1A1 (fig. 3–44).	*b.* Test 37AR1A1A1 as described in para 4–113.
Meter M1 indication low or zero in *b*(2)(*e*) above.	*a.* Defective resistor assembly 37AR1A1A2 (fig. 3–42).	*a.* Set switches S13 and S1 to OFF. Disconnect the 600V line from E1 of resistor assembly 37AR1A1A1. Check and replace 37AR1A1 if shorting to ground (44K ohms).
	b. Defective radio interference filter 37AR1A1FL2 (fig. 3–44).	*b.* Remove the 600V line from E2 and E1 of 37AR1A1FL2. Check and replace 37AR-1A1FL2 if shorting to ground.

Symptom	Probable cause	Checks and corrective measures
	c. 600V line shorting to ground	*c.* Check and replace 37AR1A1W1A1FL1 if shorting to ground.
	d. C3, C10, C7 or C14 shorting to ground (fig. 4–208).	*d.* Check C3, C10, C7 and C14 for short circuit to ground. Replace as required.
ter M indicat'on out of specified imits *b* (2) (*f*) above.	Defective output tube 37AR1AR1V2 (fig. 3–44).	Replace output tube.
w pov meter indication in *b* (3) *a*) ab e.	Defective output tube 37AR1AR1V2 (fig. 3–44).	Replace output tube.
licati out of specified limits in (4) and (*e*) above.	Defective driver tube 37AR1AR1V1 (fig. 3–44).	Replace driver tube.
norm indication in *b* (5) (*f*) bove	*a.* Defective low pass filter 37AR1A1FL1 (fg. 3–44). *b.* Defective RF power monitor 37AR1A2 (fg. 3–44).	*a.* Test 37AR1A1FL1 as described in para 4–114. *b.* Test 37AR1A2 as described in para 4–117.
ter M indication out of specified mits hen test facility switch S12 et to WR OUT or REFL OUT.	*a.* Defective wiring	*a.* Check the continuity between pin 3 of 37AR1A1W1J4 (fig. 3–42) and pin 27 of 37AR1A1W1A1P1 (fg. 3–44). Check the continuity between pin 1 of 37AR1A1W1J4 and pin 26 of 37AR1A1-W1A1P1.
	b. Defective power monitor 37AR1A2 (fig. 3–44).	*b.* Test 37AR1A2 as described in para 4–117.
vol ge indication abnormal in (6)) above.	Defective voltage regulator assembly 37AR1A1A1 (fg. 3–44).	Test 37AR1A1A1 as described in para 4–113.
norm l vswr indications in *b* (7) (*e*) nd above.	*a.* Defective cable connections between stages (fg. 7–1). *b.* Transmitter not peaked	*a.* Check cable connections and then cable connectors if necessary. *b.* Retune transmitter.

11. Voltage Regulator Assembly 37AR1A1A1 or 38AR1A1A1

a. Test Equipment and Material Required.

Equipment	Common name
t Fility, Transmitter S-166(V)1/GRM-95(V).	Transmitter test facility
tmeter, Digital AN/GSM-4.	Digital voltmeter (DVM)
ltimeter TS-352B/U	Multimeter
wer upply Lambda K-2FM.	Variable power supply
ist, Variable 0–12 ohms 0W	12-ohm variable resistor
ist, Variable 0–1 ohm 0W	1-ohm variable resistor
sis nce Bridge ZM-4/U ed, est SAC-SK-002	Resistance bridge
sis r, Fixed 10K ohm 2W	10K-ohm fixed resistor
ce ory Kit, Test Facilities Se MK-1173(V)1/GRM-95( ).	

b. Test Procedures.

(1) *Driver regulator checks.*

(*a*) Adjust the variable power supply for 7.2v dc using the DVM.

(*b*) Adjust the 12 ohms variable resistor for 5.17 ohms using the resistance bridge.

(*c*) Connect the test equipment as shown in A, figure 4–211 with the multimeter set to the 10V DC range.

(*d*) The multimeter should indicate between 1.7 and 4.7v dc.

(*e*) The DVM should indicate between 5.8 and 6.6v dc.

(*f*) If the multimeter indication is not within the limits specified in (*d*) above, adjust the collector resistance of transistor 37/38AR1A1A1A1Q3 by connecting or disconnecting shorting links between terminal points. The three strapping options (fig. 4–212) are—

NOTE

E27 and E28 should never be connected together.

1. No connections between E26, E27 or E28 (both resistors R16 and R17 in circuit).

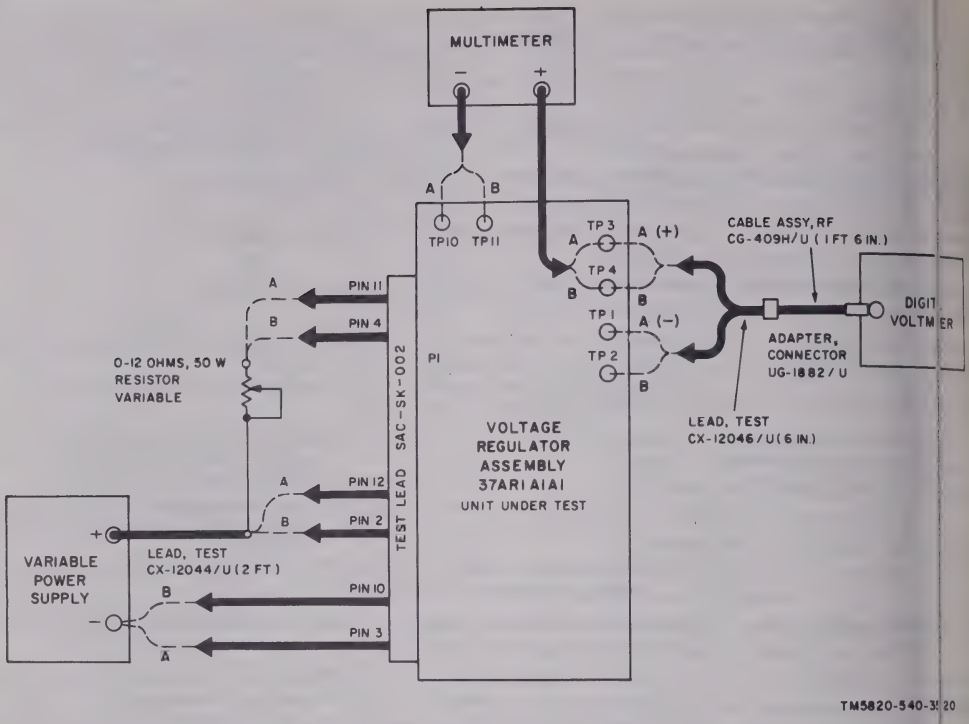

Figure 4-211. Voltage regulator assembly 37AR1A1A1 or 38AR1A1A1, test setup.

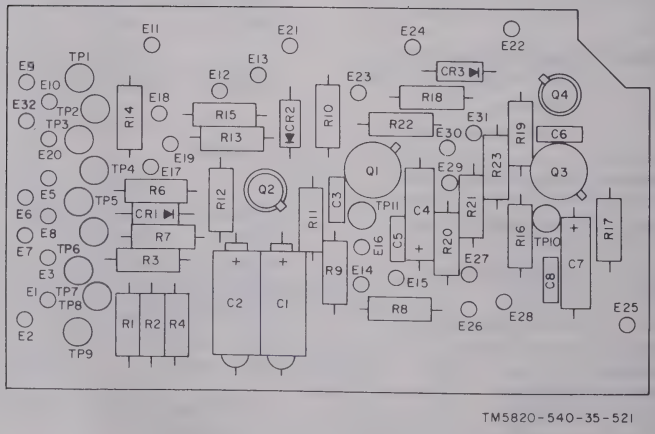

Figure 4-212. Voltage regulator subassembly 37AR1A1A1A1 or 38AR1A1A1A1 parts location.

2. A shorting link between E26 and E27 16 o y in circuit).

3. A shorting link between E26 and E28 17 o y in circuit).

y) If the DVM indication is not within lim s specified in (*e*) above, adjust the base ista e (using shorting links) of 37/ AR1 1A1A1Q4. The three strapping options —

1. No connections between E29, E30 or 1 (b th R21 and R23 in circuit).

2. A shorting link between E29 and E31 23 dly in circuit).

3. A shorting link between E29 and E30 oth 21 and R23 short circuited).

(2 *Output regulator checks.*

(*a*) Connect the test equipment as shown B, f ure 4–211.

(*b*) The multimeter should indicate twe n 1.7 and 4.7v dc.

(*c*) The DVM should indicate between 5.8 d 6.v dc.

(*d*) If the multimeter indication is not thi the limits specified in (*b*) above, adjust e ollector resistance of transistor 37/ AR A1A1A1Q1. The three strapping options e—

CAUTION

E5 and E16 should never be connected t gether.

1. No connections between E14, E15 or 6 (oth R8 and R9 in circuit)

2. A shorting link between E14 and E15 9 dly in circuit).

3. A shorting link between E14 and E16 8 dly in circuit).

(*e*) If the DVM indication is not within l its specified in (*c*) above, adjust the base sis nce of 37/38AR1A1A1A1Q2. The three ap ing options are—

1. No connection between E17, E18 or 9 oth R13 and R15 in circuit).

2. A shorting link between E17 and E19 15 nly in circuit).

3. A shorting link between E17 and E18 ot R13 and R15 short circuited).

3) *Output line and load regulation checks.*

(*a*) Adjust the variable power supply for v c using the DVM.

(*b*) Adjust the variable resistor for 4.83 m using the resistance bridge.

(*c*) Connect the test equipment as shown in B, figure 4–211.

(*d*) The DVM should indicate between 5.8 and 6.6v dc.

(*e*) Adjust the variable power supply for 8.0v dc using the DVM.

(*f*) Reconnect the DVM between TP4(+) and TP2(—) on the unit under test.

(*g*) The DVM should indicate between 5.8 and 6.6v dc.

(*h*) Adjust the variable resistor for 5.50 ohms using the resistance bridge.

(*i*) Reconnect the variable resistor as shown in B, figure 4–211.

(*j*) The DVM should indicate between 5.8 and 6.6v dc.

(*k*) Adjust the variable power supply for 6.4 v dc using the DVM.

(*l*) Not used.

(*m*) Reconnect the DVM between TP4(+) and TP2(—) on the unit under test.

(*n*) The DVM should indicate between 5.8 and 6.6v dc.

(4) *Driver line and load regulation checks.*

(*a*) Connect the test equipment as shown in A, figure 4–211.

(*b*) The DVM should indicate between 5.8 and 6.6v dc.

(*c*) Adjust the variable power supply for 8.0v dc using the DVM.

(*d*) Reconnect the DVM between TP3(+) and TP1(—) on the unit under test.

(*e*) The DVM should indicate between 5.8 and 6.6v dc.

(*f*) Adjust the variable resistor for 4.83 ohms using the resistance bridge.

(*g*) Reconnect the variable resistor as shown in A, figure 4–211.

(*h*) The DVM should indicate between 5.8 and 6.6v dc.

(*i*) Adjust the variable power supply for 6.4v dc using the DVM.

(*j*) Reconnect the DVM between TP3(+) and TP1(—) on the unit under test.

(*k*) The DVM should indicate between 5.8 and 6.6v dc.

(5) *Short circuit protection check.*

(*a*) Adjust the 1-ohm variable resistor for 1 ohm using the resistance bridge.

(*b*) Set the multimeter to the 10 A DC range and connect the test equipment as shown in A, figure 4–213.

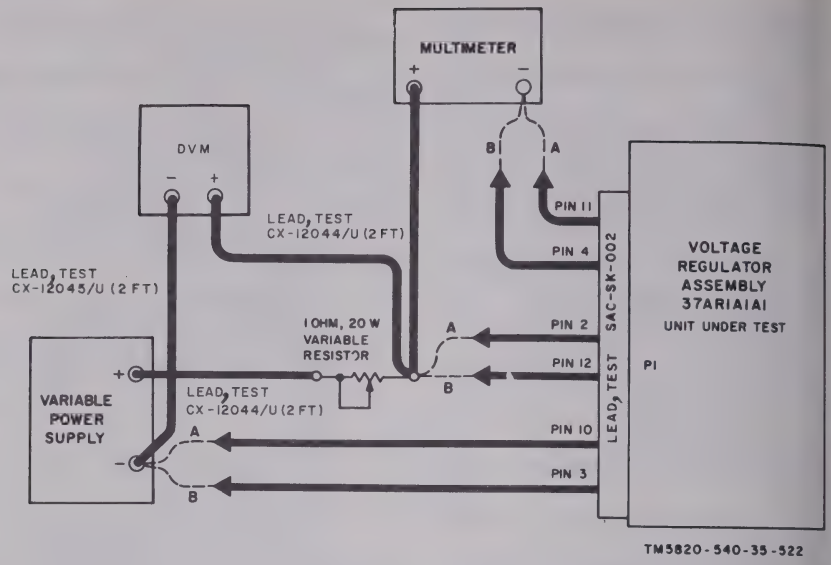

Figure 4-213. Voltage regulator assembly 37AR1A1A1 or 38AR1A1A1 short circuit protection check, test setup.

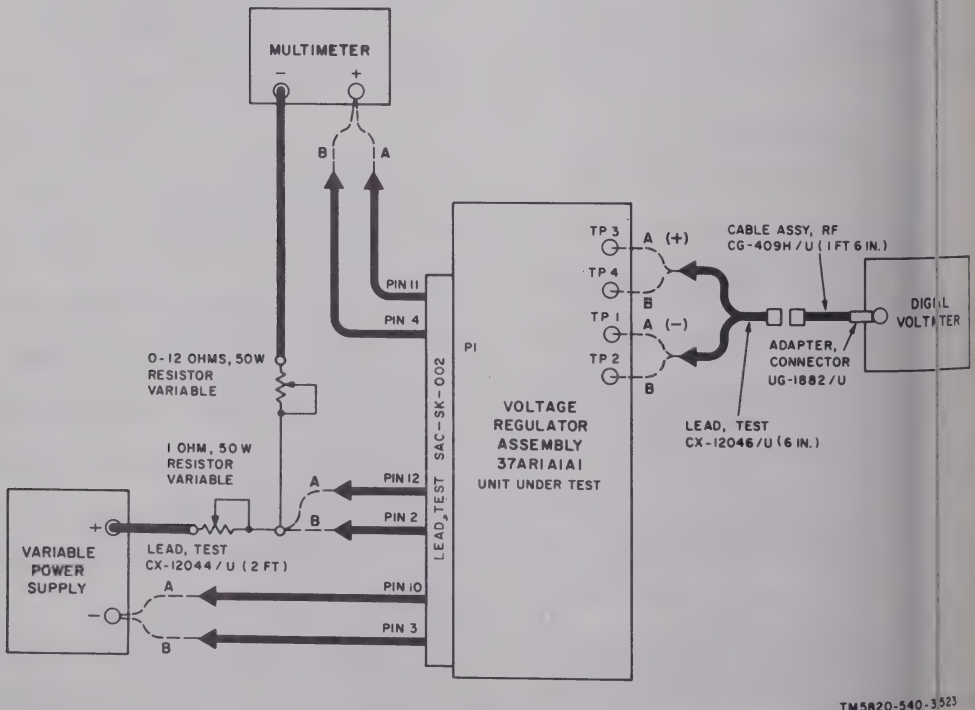

Figure 4-214. Voltage regulator assembly 37AR1A1A1 or 38AR1A1A1 maximum current check, test setup.

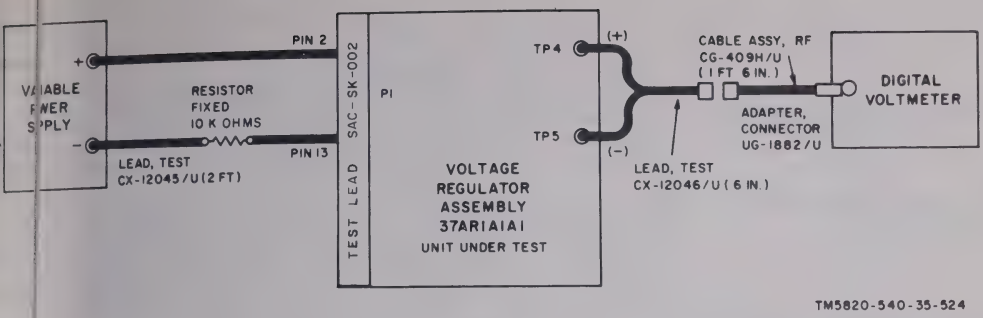

Figure 4–215. Voltage regulator assembly 37AR1A1A1 or 38AR1A1A1 automatic level control voltage check, test setup.

(*c*) Adjust the variable power supply for 1v dindicated on the DVM.

(*d*) The multimeter should indicate twen 1 and 3.5 amperes.

(*e*) Adjust the variable power supply for)v dindicated on the DVM.

(*f*) The multimeter should indicate twen 1 and 3.5 amperes.

(*g*) Connect test eequipment as shown in figre 4–213.

(*h*) The multimeter should indicate twen 1 and 3.5 amperes.

(*i*) Adjust the variable power supply for 4 v c using the DVM.

(*j*) The multimeter should indicate twen 1 and 3.5 amperes.

6) *Maximum current check.*

(*a*) Connect the test equipment as shown A,igure 4–214.

(*b*) Adjust the variable power supply for 0v c using the DVM connected from the junc- on t the 1-ohm and the 12-ohm resistors to the ga ve terminal of the variable power supply.

(*c*) Adjust the 12-ohm variable resistor for ma imum current indication on the multimeter. he ultimeter indication should not exceed 3.5 mp es.

(*d*) Connect the test equipment as shown B figure 4–214.

(*e*) Adjust the 12-ohm variable resistor for a maximum current indication on the multimeter. The multimeter indication should not exceed 3.5 amperes.

(*f*) Adjust the variable power supply for 6.4v dc using the DVM.

(*g*) Reconnect the DVM as shown in B, figure 4–214.

(*h*) Adjust the 12-ohm variable resistor for a 1.6-ampere indication on the multimeter. The DVM should indicate 5.68v dc or greater.

(*i*) Connect the test equipment as shown in A, figure 4–214.

(*j*) Adjust the 12-ohm variable resistor for a 1.6 ampere indication on the multimeter.

(*k*) The DVM should indicate 5.68v dc or greater.

(7) *Automatic level control voltage check.*

(*a*) Adjust the variable power supply for 24v dc using the DVM.

(*b*) Connect the test equipment as shown in figure 4–215.

(*c*) The DVM should indicate between 13 and 15v dc.

(8) *Output and driver current limiter and metering resistors check.* Check resistors R1, R2, R3, R4 and R7 on voltage regulator subassembly 37/38AR1A1A1A1 (figs. 4–212 and 2–63).

c. Troubleshooting (fig. 2–63).

Symptom	Probable cause	Checks and corrective measures
o driver filament voltage in (*e*) above.	*a.* Transistor 37/38AR1A1A1Q2 open circuit (fig. 4–216).	*a.* Check transistor according to resistance charts in *d* below. Replace if necessary.
	b. Transistors 37/38AR1A1A1A1Q3 and Q4 short circuit (fig. 4–212).	*b.* Check transistors according to resistance charts in *d* below. Replace if necessary.

Symptom	Probable cause	Checks and corrective measures
	c. Diode 37/38AR1A1A1A1CR3 short circuit.	*c.* Check for short circuit using m meter on resistance scale, Replace if nec ary.
2. Driver filament voltage high or low in *b* (1) (*e*) above.	Driver reguiltor transistors 37/38AR1A1A1A1Q3 and Q4 defective.	Check transistors according to resist ce charts in *d* below and check associate circuitry using multimeter on resistance sc . Replace if necessary.
3. No output filament voltage in *b* (2) (*c*) above.	*a.* Transistor 37/38AR1A1A1A1Q1 open circuit (fig. 4–216).	*a.* Check transistor according to resistance chart in *d* below. Replace if ne sary.
	b. Transistors 37/38AR1A1A1A1A1Q1 and Q2 short circuit (fig. 4–212).	*b.* Check transistors according to resistance chart in *d* below. Replace if ne ssary.
	c. Diode 37/38AR1A1A1A1CR2 short circuit.	*c.* Check diode using multimeter o resistance scale. Replace if necessary.
4. Output filament voltage high or low in *b* (2) (*c*) above.	Output regulator transistors 37/38AR1A1A1A1Q1 and Q2 faulty.	Check transistors according to resis nce chart in *d* below and check associate circuitry using multimeter on resistance sc . Replace if necessary.
5. Output line regulation poor in *b* (3) (*g*) and (*n*) above.	Transistor 37/38AR1A1A1A1Q1 faulty.	Check transistor according to resis nce chart in *d* below and check associate circuitry using multimeter on resistance sca
6. Output load regulation poor in *b* (3) (*d*) and (*j*) above.	*a.* Transistor 37/38AR1A1A1A1Q2 faulty.	*a.* Check trasistor according to sistance chart in *d* below.
	b. Diode 37/38AR1A1A1A1CR2 faulty.	*b.* Check voltage drop across zener ode using multimeter on voltage scale. ltage indication should be 4.7v dc ± 5 . Replace diode if necessary.
7. Driver line regulation poor in *b* (4) (*e*) and (*k*) above.	Transistor 37/38AR1A1A1A1Q3 faulty.	Check transistor according to resis nce chart in *d* below and check associate circuitry using multimeter on resistance ran e.
8. Driver load regulation poor in *b*(4)(*b*) and (*h*) above.	*a.* Transistor 37/38AR1A1A1A1A1Q4 defective.	*a.* Check transistor according to esistance chart in *d* below and check ass iated circuitry using multimeter on esistance range.
	b. Diode 37/38AR1A1A1A1A1CR3 defective.	*b.* Check voltage drop across d e using multimeter on voltage scal Voltage should be 4.7v dc ± 5%. Rep ce diode if necessary.
9. Driver short circuit current too high in *b*(5)(*d*) above.	*a.* Transistor 37/38AR1A1A1A1A1Q4 defective.	*a.* Check transistor according to esistance chart in *d* below and associate circuitry using multimeter on resistance cale.
	b. Diode 37/38AR1A1A1A1A1CR3 defective.	*b.* Check voltage drop across diode u g multimeter on voltage scale. Mul eter indication should be 4.7v dc ± 5% Replace diode if necessary.
10. Output short circuit current too high in *b*(5)(*h*) and (*j*) above.	*a.* Transistor 37/38AR1A1A1A1A1Q2 defective.	*a.* Check transistor according to esistance chart in *d* below and check ssociated circuitry using multimeter on esistance scale.
	b. Diode 37/38AR1A1A1A1A1CR2 defective.	*b.* Check voltage drop across diod Voltage should be 4.7v dc ± 5%. Repla diode if necessary.
11. Output maximum current high in *b*(6)(*c*) above.	*a.* Resistor 37/38AR1A1A1A1R1 short circuit (fig. 4–216).	*a.* Check R1 using multimeter on esistance scale. Replace R1 if necessary.
	b. Transistor 37/38AR1A1A1A1Q1 short circuit.	*b.* Check Q1 according to resistance hart in *d* below. Replace if necessary.
12. Driver maximum current high in *b*(6)(*e*) above.	*a.* Resistor 37/38AR1A1A1A1R2 short circuit.	*a.* Check R2 using multimeter on esistance scale. Replace if necessary.
	b. Transistor 37/38AR1A1A1A1Q2 short circuit.	*b.* Check Q1 according to resistance hart in *d* below. Replace if necessary.
13. Automatic level control voltage incorrect in *b*(7)(*c*) above.	*a.* Diode 37/38AR1A1A1A1A1CR1 defective (fig. 4–212).	*a.* Check voltage drop across CR1 u g multimeter on voltage scale, Mult eter indication should be 13v dc ± 5% Replace if necessary.
	b. Resistor 37/38AR1A1A1A1A1R6 open circuit.	*b.* Check resistance using multimete on resistance scale. Replace if necessary

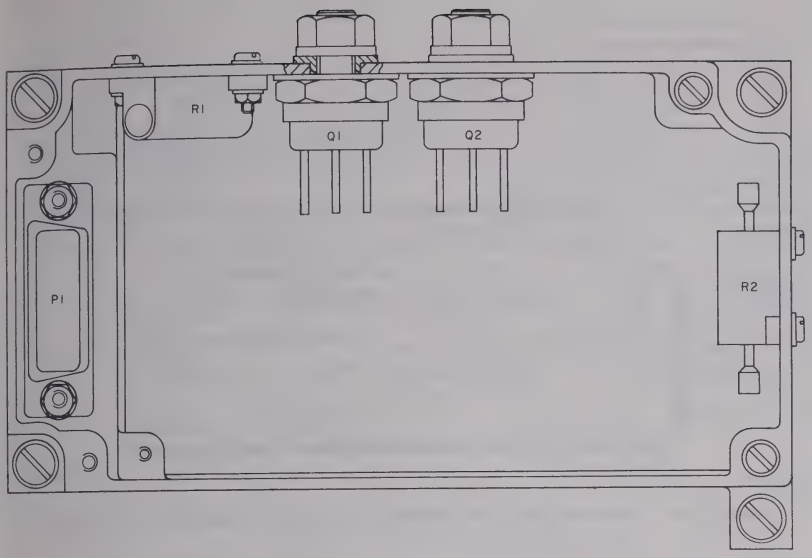

Figure 4–216. Voltage regulator assembly 37AR1A1A1 or 38AR1A1A1 parts location.

d. Transistor Resistance Measurements.

NOTE

All resistances measured with the allocated multimeter.

Ref.	Transistor Type	Base(−) Emitter(+) Res (ohms)	Base(−) Emitter(+) Multimeter range	Base(−) Collector(+) Res (ohms)	Base(−) Collector(+) Multimeter range	Base(+) Emitter(−) Res (ohms)	Base(+) Emitter(−) Multimeter range	Base(+) Collector(−) Res (ohms)	Base(+) Collector(−) Multimeter range
Q	2N1724	265	X 100	260	X 100	265	X 100	260	X 10 0
Q	2N1724	265	X 100	260	X 100	265	X 100	260	X 10 0
Q	2N697	Infinity	X 10,000	Infinity	X 10,000	805	X 100	750	X 10 0
Q	2N2907	885	X 100	885	X 100	1200	X 100	Infinity	X 10,00 0
Q	2N697	Infinity	X 10,000	Infinity	X 10,000	805	X 100	755	X 10 0
Q	2N2907	870	X 100	870	X 100	1200	X 100	Infinity	X 10,000

-11. Low Pass Filter 37AR1A1FL1

a. est Equipment and Material Required.

Equipment	Common name
est acility, Transmitter TS 866(V)1/GRM–95(V).	Transmitter test facility
cce ory Kit, Test Facilities Se MK–1173(V)1/GRM–95( ).	Accessory kit
ene ator, Sweep SG–888	Sewep generator
sci scope AN/USM–281	Oscilloscope
ene ator, Signal SG–40)/U.	Signal generator No. 1.
Generator, Signal SG–340A/G.	Signal generator No. 2.
Generator, Signal SG–644/U	Signal generator No. 3.
Indicator, Standing Wave Ratio AN/UPM–108.	Vswr indicator
Adapter-Connector Omni Spectra 21190.	Adapter-connector OS21190
Adapter-Connector Omni Spectra 21200.	Adapter-connector OS21200
Adapter-Connector Omni Spectra 21030.	Adapter-connector OS21030
Detector RF XD–23A	Detector XD–23A.

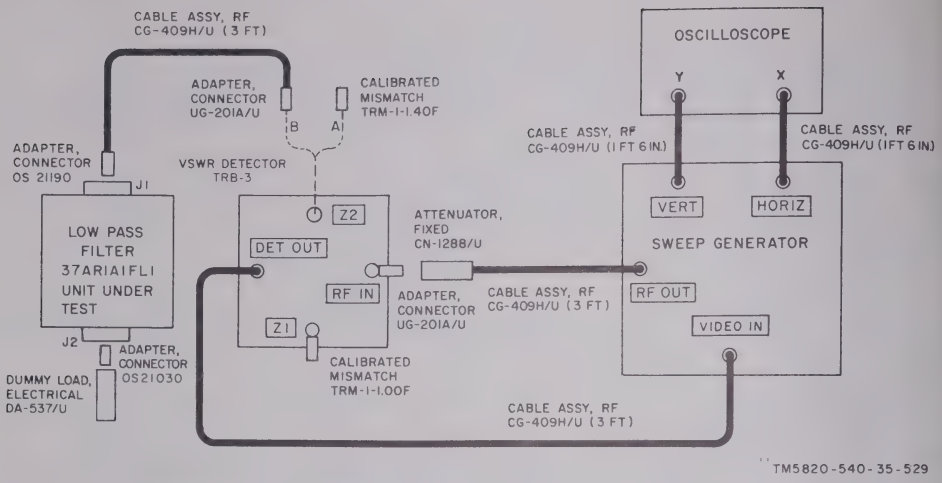

Figure 4–217. Low pass filter 37AR1A1FL1 or 38AR1A1FL1 vswr check, test setup.

b. Test Procedures.

(1) *Vswr check.*

(*a*) Connect the test equipment as shown in A, figure 4–217.

(*b*) Adjust the sweep generator controls to obtain a sweep between 395 and 705 MHz.

(*c*) Adjust the oscilloscope controls and the sweep generator output level control to obtain a convenient display on the oscilloscope.

(*d*) Mark the resultant display on the graticule of the oscilloscope. The display represents a vswr of 1:1.40.

(*e*) Connect the test equipment as shown in B, figure 4–227. The vswr displayed on the oscilloscope should not exceed the line marked (*d*) above.

(*f*) Reverse the unit under test (i.e., connect the dummy load to J1 and connect J2 to the vswr detector TRB–3). The vswr displayed on the oscilloscope should not exceed the line marked in (*d*) above.

(2) *Insertion loss in passband check.*

(*a*) Connect the test equipment as shown in A, figure 4–218.

(*b*) Turn the three variable attenuators to 0.

(*c*) Set signal generator No. 1 to 395 MHz and 1 kHz modulated square wave output. Adjust the level control for maximum output.

(*d*) Adjust the vswr indicator for a convenient meter indication and record the indi tion obtained.

(*e*) Connect the test equipment as sho in B, figure 4–218.

(*f*) Adjust variable attenuator CN–1292 to obtain the indication recorded in (*d*) abo The attenuator setting should not exceed 0.8 db.

(*g*) Connect the test equipment as sho in C, figure 4–218.

(*h*) Turn the three variable attenuators 0.

(*i*) Set signal generator No. 2 to 705 M and 1 kHz modulated square wave output. Adj the level control for maximum output.

(*j*) Adjust the vswr indicator for convenient meter indication and record the indi tion obtained.

(*k*) Connect the test equipment as sho in D, figure 4–218.

(*l*) Not used.

(*m*) Adjust variable attenuator CN–129 U to obtain the indication recorded in (*j*) abo

(*n*) The attenuator CN–1292/U setti should not exceed 0.8 db.

(3) *Insertion loss outside the passba checks.*

(*a*) Connect the test equipment as sho in E, figure 4–218.

(*b*) Set signal generator No. 2 to 11 MHz modulated at 1 kHz and the three varia attenuators to 0.

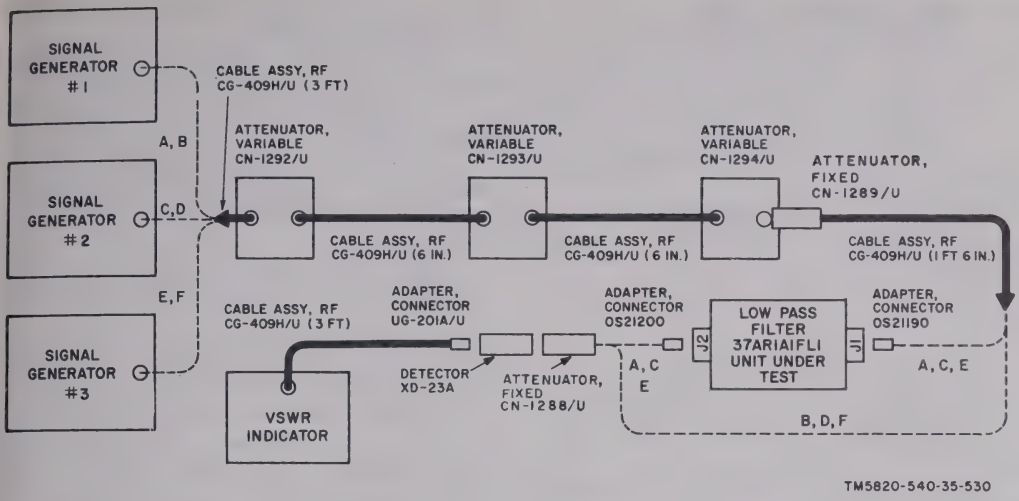

Figure 4–218. Low pass filter 37AR1A1FL1 insertion loss check, test setup.

(*c*) Adjust the vswr indicator for a convenient meter indication and record the indication.

(*d*) Connect the test equipment as shown in F, figure 4–218.

(*e*) Adjust variable attenuators to obtain the indication recorded in (*c*) above.

(*f*) The attenuator settings should be 3.0 db minimum.

(*g*) Connect the test equipment as shown in A, figure 4–219.

(*h*) Adjust signal generator No. 3 output frequency to 1400 MHz and set the output attenuators to 35 db. Adjust the vswr indicator for a convenient meter indication and record the indication obtained.

(*i*) Connect the equipment as shown in B, figure 4–219 and set the signal generator output attenuators to 0.

(*j*) The vswr indicator should indicate lower than the indication recorded in (*h*) above.

(*k*) Repeat steps (*g*) to (*j*) above with a frequency of 1500 MHz and an attenuator setting of 50 db.

NOTE

To obtain a readable indication on the vswr indicator at these settings it may be necessary to connect signal generator No. 3 direct to the detector.

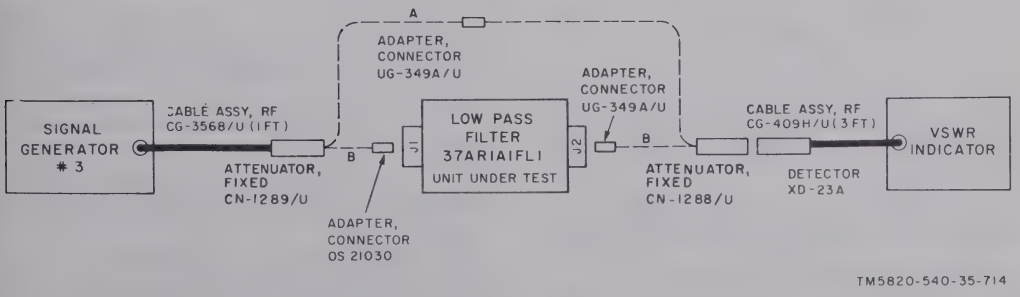

Figure 4–219. Low pass filter 37AR1A1FL1 insertion loss outside passband check, test setup.

4–115. Radio Interference Filter 37AR1A1FL2 or 38AR1A1FL2

a. Test Equipment and Material Required.

Equipment	Common name
Test Set Analyser Breakdown voltage AN/GSM–6.	Breakdown voltage tester
Multimeter TS–352B/U	Multimeter
Capacitance, Resistance, Inductance Test Set AN/URM–90.	R–L–C–bridge

b. Test Procedure.

(1) *850 volts breakdown test.*

(*a*) Connect terminal 3 to filter case and connect breakdown voltage tester between pins 1 and 3 of radio interference filter 37/38AR1A1FL2.

(*b*) Test the unit under test for breakdown at 850 volts (fig. 7–1).

(*c*) Connect the breakdown voltage tester between pins 2 and 3 of the unit under test and test it for breakdown at 850 volts.

(2) *Continuity Test.* Using the multimeter test for continuity between pins 1 and 3 and pins 2 and 3 of the unit under test.

(3) *Capacitance test.* Using R–L–C bridge measure capacitance between pins 2 and 3 of unit under test; it should not be less than 0.9 μf.

4–116. Connector-Filter Assembly 37AR1A1W1A1 or 38AR1A1W1A1

a. Test Equipment and Material Required.

Equipment	Common name
Multimeter TS–352B/U	Multimeter

b. Test Procedure. This assembly contains plugs 37/38AR1A1W1A1P1 (fig. 3–44 or 3–62) and 37/38AR1A1W1A1P2 (fig. 3–42 or 3–60). Check each circuit as follows (fig. 7–2 or 8–2).

(1) Check continuity between each pin of 37/38AR1A1W1A1P1 and its associated filter connector and between RF connector pin 2 of 37/38AR1A1W1A1P1 and center conductor of 37/38AR1A1W1A1P2.

(2) Check that no short circuit exists between any pin or center conductor and ground.

c. Repairs.

(1) The RF connector in 37/38AR1A1W1A1P1 can be replaced as follows:

(*a*) Force RF connector back into t
connector-filter assembly.

(*b*) Slide the insulating sleeve back alo
the cable and unsolder the faulty connector.

(*c*) Install the new connector on the
cable (para 4–10).

(*d*) Push the new connector into t
mounting hole in 37/38AR1A1W1A1P1 until
retaining springs snap into place, holding
connector firmly.

(2) If tests indicate that a filter or connec
requires replacement, refer to paragraph 4–140.

4–117. RF Power Monitor 37AR1A2 or 38AR1A2

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Test Facility, Transmitter TS–2866(V)1/GRC–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Drive Generator Airborne Instruments Labs Model 125.	Power signal source
Wattmeter AM/URM–120	Wattmeter
Generator, Signal SG–340A/G.	Signal generator No. 2.
Indicator, Standing Wave Ratio AN/UPM–108.	Vswr indicator
Adapter-Connector Omni Spectra 21190.	Adapter-connector OS211
Cable Assembly, Special Purpose, Electrical SAC–SK–015.	
Adapter-Connector Omni Spectra 21030.	Adapter-connector OS210

b. Test Procedures.

(1) *Insertion loss check.*

(*a*) Connect the test equipment as sho
in A, figure 4–220.

(*b*) Adjust the signal generator cont
to provide a frequency of 1000 MHz modula
with 1 kHz at a modulation level of 30 perce
Adjust the output attenuator dial to 0 db.

(*c*) Set the variable 1 db attenuator
0.5 db.

(*d*) Adjust the vswr indication controls
a convenient midscale indication. Record t
reading.

(*e*) Connect the test equipment as sho
in B, figure 4–220.

(*f*) Set the variable 1 db attenuator to
db. The reading in the vswr indicator must be

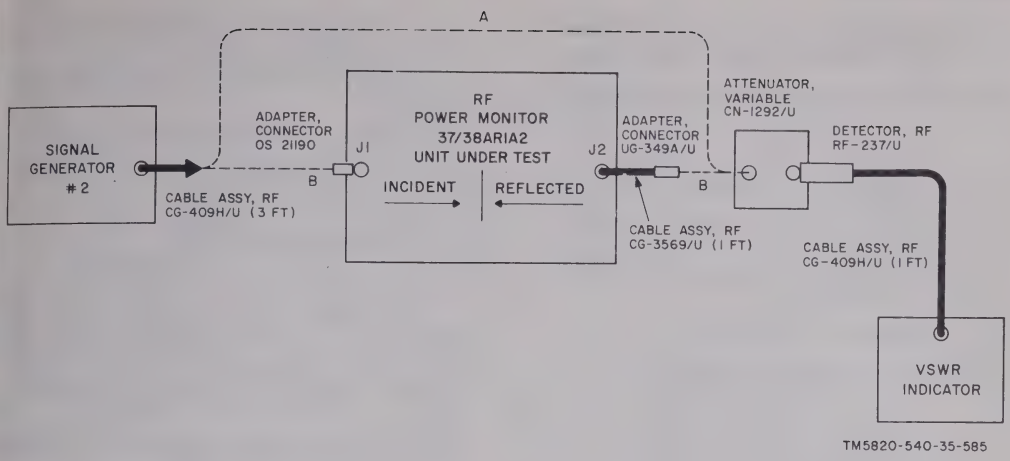

Figure 4-220. RF power monitor 37AR1A2 or 38AR1A2 insertion loss check, test setup.

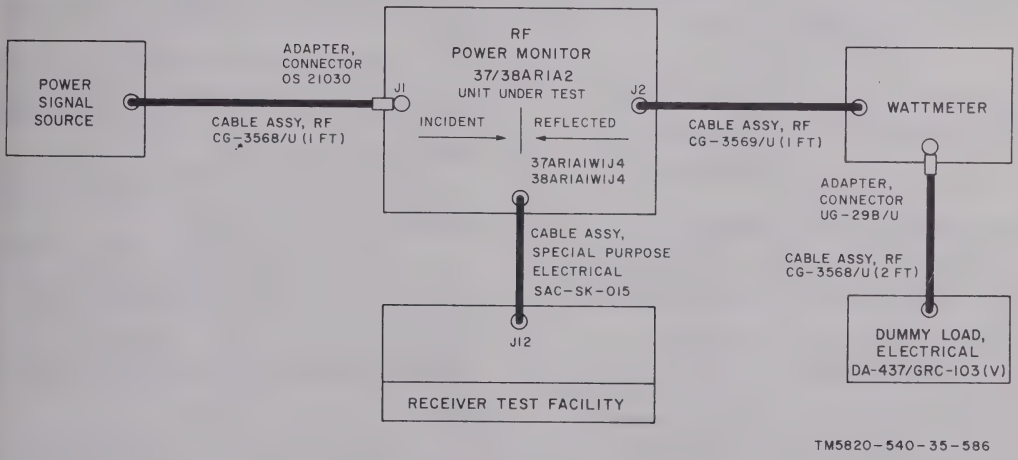

Figure 4-221. RF power monitor 37AR1A2 or 38AR1A2 power in vs voltage out check, test setup.

same as or less than that recorded in step (*d*) above. This represents an insertion loss of 0.2 db or less.

(2) *Power in vs voltage out check.*

(*a*) Connect the test equipment as shown in figure 4-221.

(*b*) Set the receiver test facility switches S1 to ON, S5 to S6 and S6 to XMTR PWR.

(*c*) Adjust the power signal source controls to provide a frequency of 1000 MHz at an output level of 25 watts as indicated on the wattmeter. The meter M1 of the receiver test facility should indicate between 40 and 60 percent of full scale.

(*d*) Switch off the power signal source.

(*e*) Reverse the power meter and power signal source connections on the assembly under test.

(*f*) Set receiver test facility switch S6 to REFL PWR.

(*g*) Switch on the power signal source.

(*h*) Repeat steps (*c*) and (*d*) above for a power signal source output level of 12 watts.

4-118. Amplifier-Converter AM-4317/GRC-103(V) (Band II Receiver RF Head)

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Receiver TS-2867(V)1/GRM-95(V).	Receiver test facility
Test Facility, Transmitter TS-2866(V)1/GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V).	Accessory kit
Voltmeter, Electronic ME-30A/U.	VTVM
Frequency Meter AN/USM-159.	Frequency meter
Oscilloscope AN/USM-281	Oscilloscope
Generator, Sweep SF-888	Sweep generator
Wattmeter AN/URM-98	Power meter
Wattmeter AN/URM-120	Wattmeter
Drive Generator, Airborne Instruments Labs, Model 125.	Power signal source
Voltmeter, Electronic ME-247/U.	RF voltmeter
Bridge, Vswr ANZAC RB-3	Vswr bridge
Generator, Signal SG-409( )/U.	Signal generator No. 1
Generator, Signal SG-340A/G.	Signal generator No. 2
Noise Generator PRD-904	Noise generator
Circulator Melab HD-1-450	Circulator
Hybrid Junction, Anzac H-8.	
Generator, Signal AN/USM-205.	Wide range oscillator
Multimeter TS-352B/U	Multimeter
Wideband RF amplifier SM-C-696030.	
Dummy Load Telonic TRM-1-3.50F.	Calibrated Mismatch TRM-1-3.50F.
Adapter-Connector 874-QNJL (2 required).	
Adapter-Connector 874-QBJL (2 required).	
Adapter-Connector Omni Spectra 21200.	Adapter-connector OS21200
Adapter-Connector Omni Spectra 21190.	Adapter-connector OS21190

b. Test Procedures.

(1) *Functional check.*

(*a*) Remove the dust cover from the unit to be tested.

(*b*) Connect the test equipment as show in figure 4-222.

(*c*) Set the receiver test facility switch as follows:

Switch	Position
S1	ON
S5	S6
S7	AGC
S8	OFF
S6	MULTIPLIER

(*d*) Set the unit under test RCV CHANNEL and RCVR SIG controls to chan 390 and the XMTR DUPL control at least 1 channels away from the RCVR CHANNEL s ting.

(*e*) Set signal generator No. 1 to 395 M at an output level of —74 dbm.

(*f*) Adjust the MULT PEAK control the unit under test for maximum indication receiver test facility meter M1. The meter sho indicate between 10 and 45 percent.

(*g*) Set the test facility switch S6 to R SIG.

(*h*) Adjust the RCVR SIG control on unit under test for maximum indication on t facility meter M1. The VTVM should indic approximately —47 dbm.

(*i*) Repeat (*c*) through (*h*) above for channels and signal generator frequencies sho in the table below.

(*j*) At channels marked with an asterisk table below, increase signal generator No. output level until the HIGH SIGNAL lamp on receiver test facility lights. Signal generator 1 level should be between —10 dbm and +10 d as indicated on the signal generator output att uator dial.

RCVR CHANNEL and RCVR SIG channel settings	Signal generator (receiver) frequency
*390	395
430	415
470	435
510	455
550	475
*590	495
630	515
670	535
710	555
750	575
*790	595
830	615
870	635
910	655
950	675
*990	695
1010	705

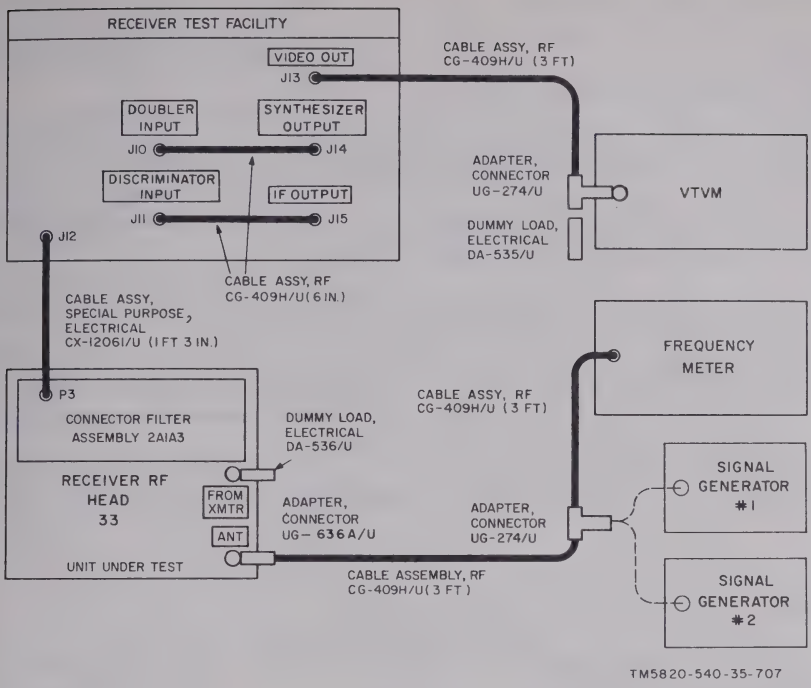

Figure 4-222. Receiver RF head 33 functional check, test setup.

NOTE

Use signal generator No. 2 for frequencies 475 MHz and above.

(2) *Noise figure.*

(*a*) Connect the test equipment as shown in A, figure 4-223.

(*b*) Set the OUTPUT LEVEL control on the noise generator to OFF.

(*c*) Set the noise generator power switch to ON and set the range switch to 10.

(*d*) Set signal generator No. 1 frequency to 395 MHz and set the output attenuator dial to —60 dbm.

(*e*) Set the receiver test facility switches as follows:

Switch	Position
S1	ON
S5	S6
S6	MULTIPLIER
S7	AGC

(*f*) On the unit under test, set the RCVR channel and RCVR SIG controls to channel 390 and the XMTR DUPL control at least 100 channels away from the RCVR CHANNEL setting.

(*g*) Adjust the MULT PEAK control on the unit under test for maximum indication on test facility meter M1.

(*h*) Set the test facility switch S6 to REC SIG and adjust the RCVR SIG control on the unit under test for maximum indication on test facility meter M1. Note the noise level indication on the VTVM (approximately —40 dbm).

(*i*) Connect the test equipment as shown in B, figure 4-223.

(*j*) Turn the noise generator OUTPUT LEVEL control to ON and adjust the OUTPUT LEVEL control to obtain the same VTVM indication as that noted in (*h*) above. The noise figure of the unit under test is read directly from the noise generator meter scale and should not exceed 8 db.

(*k*) Repeat (*a*) through (*j*) above for the equipment settings marked with an asterisk in the table in (1) (*j*) above.

(3) *Receiver protection circuit check.*

(*a*) Connect the test equipment as shown in figure 4–224.

(*b*) Set the receiver test facility switch S6 to REFL PWR.

(*c*) Set the RCVR CHANNEL and RCVR SIG controls on the receiver RF head to channel 390.

(*d*) Set the XMTR DUPL control at least 100 channels away from the RCVR CHANNEL setting.

(*e*) Set the power signal source frequency to 395 MHz and set the output level to minimum.

(*f*) Slowly increase the power signal source output level to 35 watts while observing the power meter indication and the HIGH SIGNAL alarm lamp on the test facility. The power level at J2 (33A5) should not exceed +17 dbm (+7 dbm indication on the power meter), the HIGH SIGNAL alarm lamp on the test facility should light and test facility meter M1 should indicate between 80 and 100 percent of full scale deflection.

(*g*) Repeat (*c*) through (*f*) above for all remaining channels marked with an asterisk in the table in (1) (*j*) above.

(4) *Input vswr check.*

(*a*) Connect the equipment as shown in A figure 4–225.

(*b*) Set the sweep generator center frequency to 395 MHz with a sweep width of approximately 10 MHz.

(*c*) Adjust the sweep generator output level for 0 dbm as indicated on the power meter.

(*d*) Connect the equipment as shown in F figure 4–225.

(*e*) Calibrate the oscilloscope for a vswr of 3.5:1 between 395 and 705 MHz.

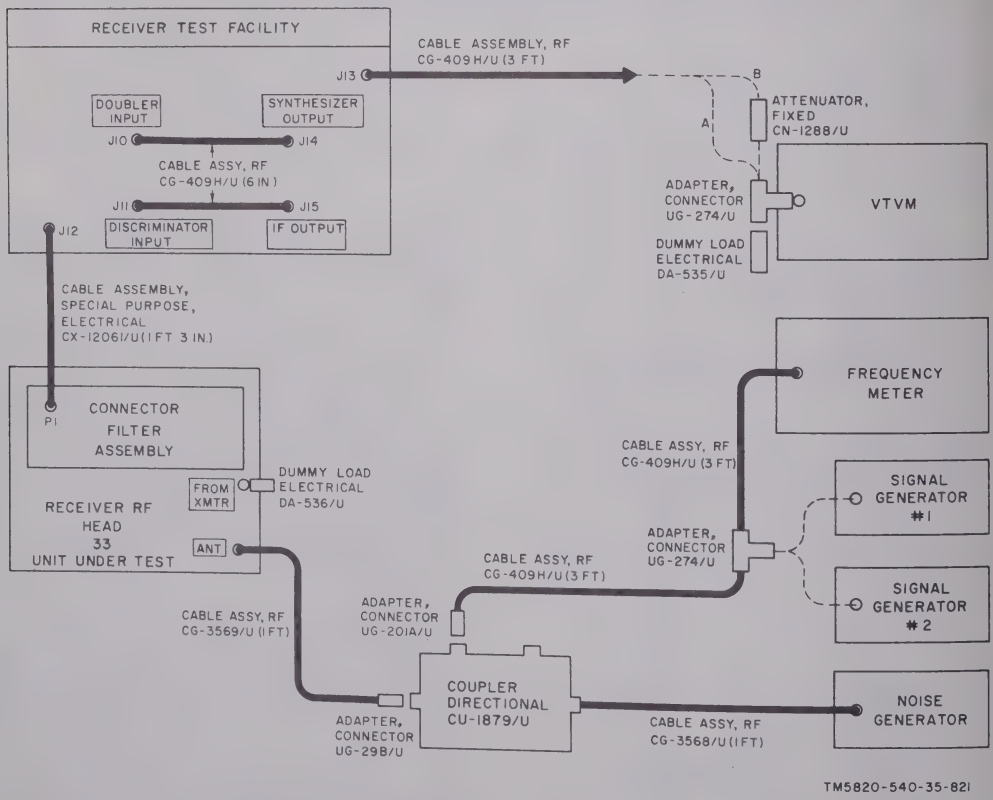

Figure 4–223. Receiver RF head, 33, noise figure check, test setup.

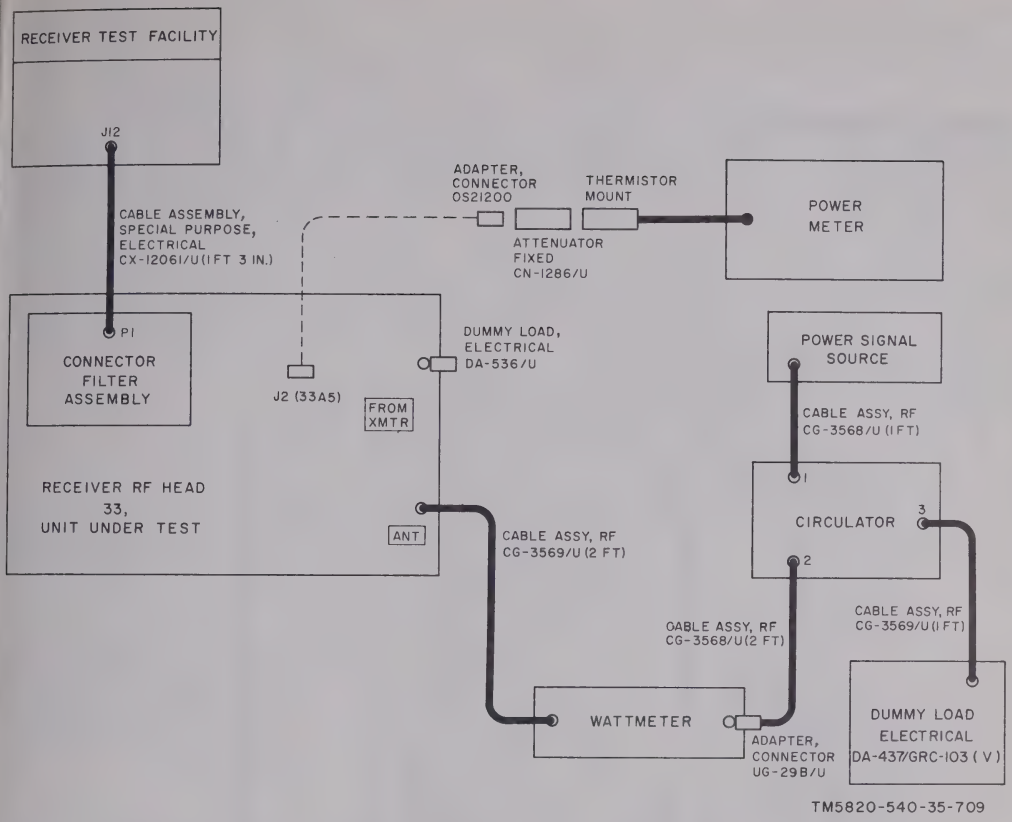

Figure 4–224. Receiver RF head, 33, receiver protection circuit check, test setup.

(*f*) Reset the sweep generator center frequency to 395 MHz.

(*g*) Connect the equipment as shown in C, figure 4–225.

(*h*) Set the RCVR SIG and RCVR CHANNEL controls on the unit under test to channel 390 and set the XMTR DUPL control at least 100 channels away from the RCVR CHANNEL setting. The vswr at the peak of the response curve, as displayed on the oscilloscope, should not exceed the 3.5:1 vswr calibration mark.

(*i*) Set signal generator No. 1 to 395 MHz.

(*j*) Adjust the wide range oscillator (wro) frequency and fine tune signal generator No. 1 to place markers at the point where the response curve intersects the 3.5:1 vswr calibration line. Note the wro frequency indicated on the frequency meter.

(*k*) Multiply the wro frequency noted in (*j*) above, by 2 to obtain the bandwidth. The bandwidth should be greater than 3.0 MHz.

(*l*) Not used.

(*m*) Repeat (*f*) throuugh (*k*) above for RCVR SIG, RCVR CHANNEL settings and signal generator frequencies listed in the table in (1) (*j*) above.

(5) *Agc check.*

(*a*) Connect the test equipment as shown in figure 4–226.

(*b*) Set signal generator No. 2 frequency to 550 MHz and set the output attenuator dial to —90 dbm.

(*c*) Set the receiver test facility switches as follows:

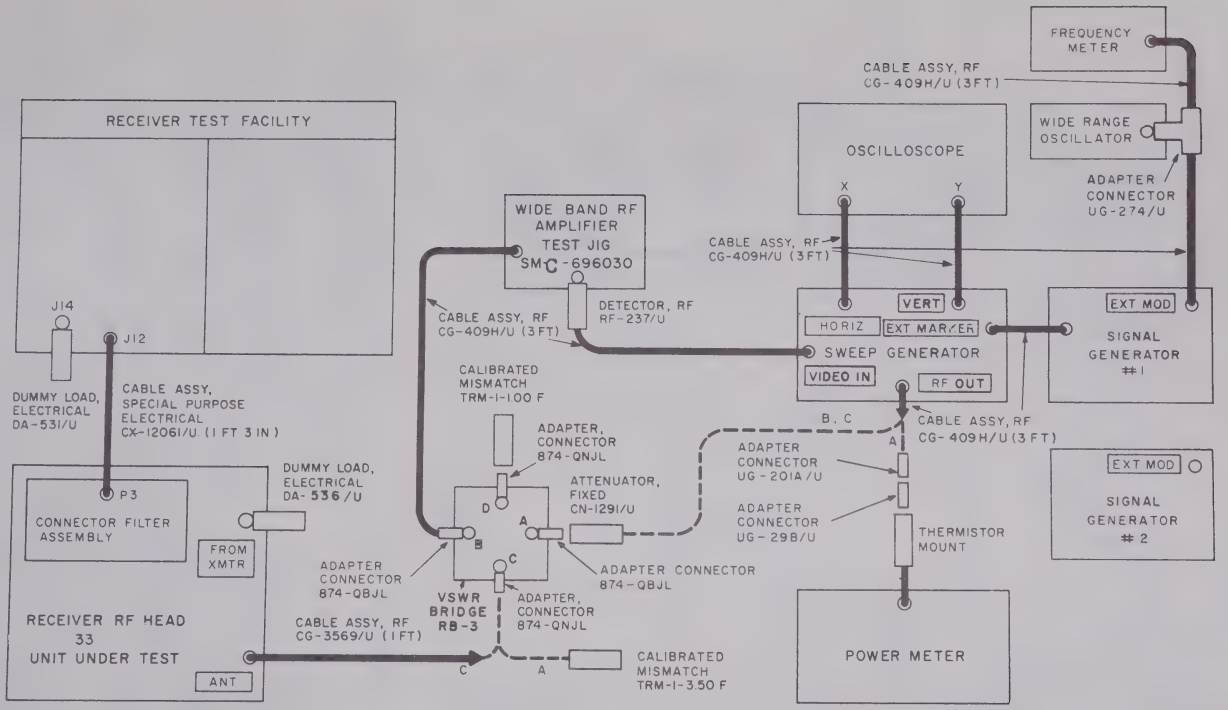

Figure 4–225. Receiver RF head, 33, input vswr check, test setup.

Switch	Position
S1	ON
S5	S6
S6	MULTIPLIER
S7	AGC

(d) Set the RCVR CHANNEL and RCVR SIG controls on the unit under test to channel 700 and adjust the MULT PEAK control for maximum indication on test facility meter M1.

(e) Adjust the RCVR SIG control for maximum indication on the RF voltmeter which should be approximately −40 dbm. Note the indication.

(f) Set signal generator No. 2 output attenuator to −50 dbm. The RF voltmeter should indicate not more than 7 db above the level noted in (e) above.

c. Troubleshooting (fig. 7-7).

Symptom	Probable cause	Checks and corrective measures
1. Test facility meter M1 indication (MULTIPLIER) below normal (*b*(1)(*f*) above).	*a.* Defective control-indicator 33A4 (fig. 3-49).	*a.* Test as described in paragraph 4-129.
	b. Defective wiring	*b.* Check continuity of metering circuit between pin 4 of 33A1W1J8 (fig. 3-56) and pin 24 of 33A1W1A1P1 (fig. 3-49). Check continuity between 33A1W1J5 and 33A1W1A1P1 (fig. 3-49).
	c. Defective frequency mixer stage 33A7 (fig. 3-56).	*c.* Check metering circuit of 33A7 as described in paragraph 4-132.
2. High signal alarm operates outside specified limits (*b*(1)(*j*) above).	Defective signal level control-monitor 33A5 (fig. 3-53).	Test as described in paragraph 4-130.
3. Noise figure exceeds 8.0 db at one or more frequencies (*b*(2)(*j*) and (*k*) above).	*a.* Defective frequency mixer stage 33A7 (fig. 3-56).	*a.* Test as described in paragraph 4-132.
	b. Defective IF amplifier 33AR1 (fig. 3-56).	*b.* Test as described in paragraph 4-133.
4. Power meter indication exceeds +7 dbm calibration level at one or more frequencies (*b*(3)(*f*) above).	Defective signal level control-monitor 33A5 (fig. 3-53).	Test as described in paragraph 4-130.
5. Indication on test facility meter M1 low or zero when S6 at REFL PWR position (*b*(3)(*f*) above).	*a.* Defective wiring	*a.* Check the continuity from pin 1 of 33A1-W1J3 (fig. 4-227) to pin 25 of 33A1W1-A1P1 (fig. 3-49) and from pin 3 of 33A1-W1J3 to pin 2 of 33A1W1A1P1.
	b. Defective RF power monitor 33A3 (fig. 4-227).	*b.* Replace 33A3 as described in paragraph 4-149.
6. Input vswr exceeds 3.5:1 (*b*(4)(*h*) above).	*a.* Defective duplexer subassembly 33A1A1 (fig. 3-56).	*a.* Check output vswr at J1 of impedance matching network 33A1A1Z1 (paragraph 4-120*b*(2)).
	b. Damaged connectors	*b.* If above vswr check is normal check that connectors from ANT. to the impedance matching network 33A1A1Z1 are not damaged.
	c. Defective RF power monitor 33A3 (fig. 4-227).	*c.* If connectors are undamaged replace power monitor 33A3 as described in paragraph 4-149.
7. Bandwidth less than 3 MHz at one or more frequencies (*b*(4)(*k*) above).	Defective duplexer subassembly 33A1A1 (fig. 3-56).	Test 33A1A1 as described in paragraph 4-120.
8. Agc action not as specified in (*b*(5)(*f*) above).	Defective IF amplifier 33AR1 (fig. 3-56).	Test IF amplifier as described in paragraph 4-133.

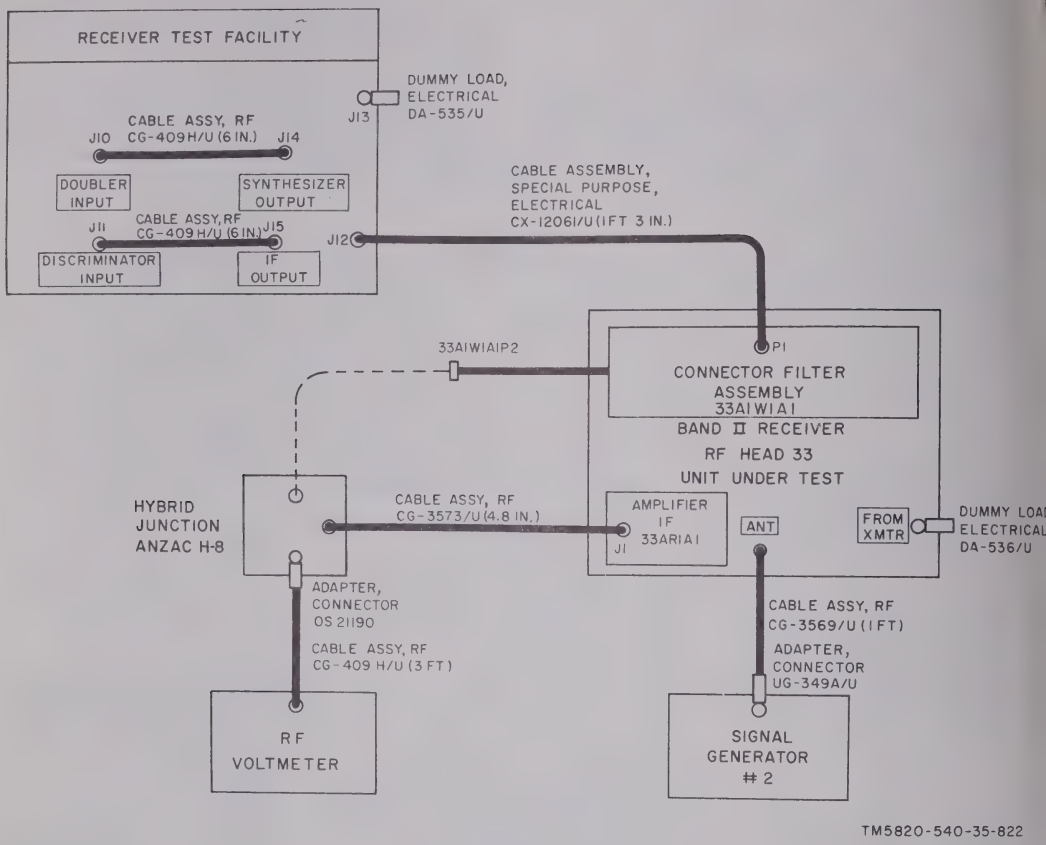

Figure 4-226. Receiver RF head, 33, agc check, test setup.

d. Alignment Procedure (Local Oscillator and Voltage Control Assembly Alignment).

(1) Connect the test equipment as shown in A, figure 4-228.

(2) Set the receiver test facility switches as follows:

Switch	Position
S1	ON
S5	S6
S6	MULTIPLIER
S7	AGC

(3) Set the RCVR CHANNEL and RCVR SIG controls on the unit under test to channel 700 and set the XMTR DUPL at least 100 channels away from the RCVR CHANNEL setting.

NOTE

Do not allow the duplexer gears to move while adjusting the multiplier group and the voltage control assembly gears.

(4) Loosen the clamp of gear A (fig. 3-53) an rotate the gear for maximum indication on receiv test facility meter M1.

(5) Tighten the clamp of gear A while insurin that meter M1 indication remains at maximum.

(6) Set receiver test facility switch S1 to OF

(7) Set the power supply voltage control full counterclockwise and set the current limiter contr to 0.3A.

(8) Connect the test equipment as shown in F figure 4-228.

(9) Adjust the power supply output voltage t 57.4 volts.

(10) Remove frequency mixer stage 33A7.

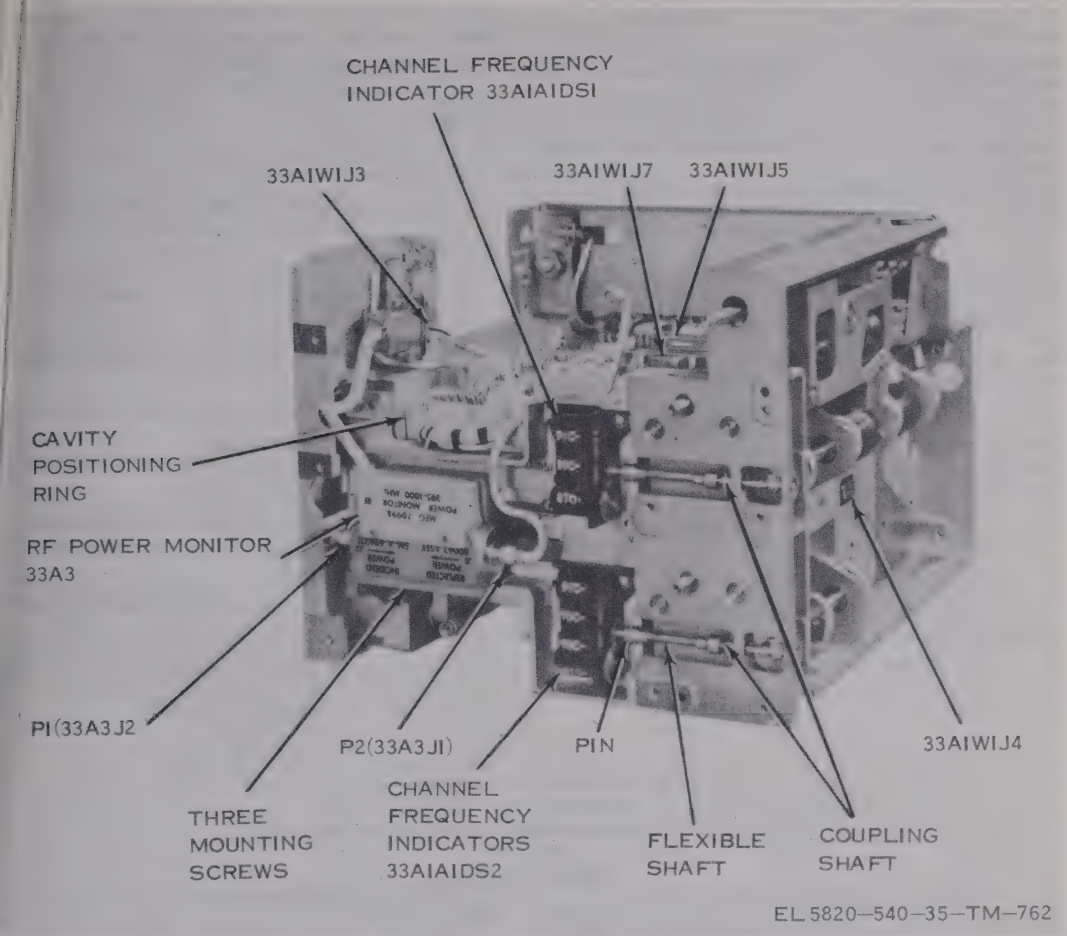

Figure 4-227. Receiver RF head 33 front view, front panel removed.

fig. 3-56) and connect the test equipment as hown in C, figure 4-228.

(11) Set test facility switch S1 to ON.

(12) Loosen the clamp of gear B (fig. 3-53) nd rotate the gear for an indication of 13.3 volts n the DVM.

(13) Tighten the clamp of gear B while nsuring that the DVM indication remains at 13.3 olts.

(14) Repeat functional check in (1) above.

-119. Duplexer 33A1

his assembly comprises duplexer subassembly 3A1A1 (para 4-120), voltage control assembly 33A1A2 (para 4-155), speed decreaser gear assembly 33A1MP1 (para 4-151), and branched wiring harness 33A1W1 (fig. 7-7). There is no overall test for the duplexer. Refer to the appropriate paragraphs or figure for testing and/or replacement procedures for the individual units which make up the duplexer.

4-120. Duplexer Subassembly 33A1A1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facilities Set AN/GRM-95(V)1.	Test facilities set

Equipment	Common name
Generator, Sweep SG-888	Sweep generator
Oscilloscope AN/USM-281	Oscilloscope
Generator, Signal SG-409( )/U.	Signal generator No. 1
Generator, Signal SG-340A/G.	Signal generator No. 2
Generator, Signal AN/USM-205.	Wide range oscillator
Frequency Meter AN/USM-159.	Frequency meter
Adapter-Connector Omni Spectra 21190 (2 required).	Adapter-connector OS21190
Low Pass Filter TLC-1000-5EF.	Filter TLC-1000-5EF
Detector, RF XD-23A	Detector XD-23A
Adapter-Connector Omni Spectra 21020.	Adapter-connector OS21020
50-ohm Load Omni Spectra 20020P (2 required).	50-ohm load OS20020P
Adapter-Connector Omni Spectra 217.	Adapter-connector OS217

b. Test Procedures.

(1) *Test setup calibration.*

(*a*) Set up the test equipment as shown in A, figure 4-229.

(*b*) Turn the sweep generator ouput attenuator to 0 db and sweep width to maximum. Insure that the sweep generator output is level from at least 390 to 710 MHz.

(*c*) Mark the 2.0:1 vswr response on the oscilloscope graticule.

NOTE

Do not readjust the oscilloscope vertical gain or positioning controls during the following tests.

(2) *Transmitter filter vswr, bandwidth and backlash.*

(*a*) Connect the test equipment as shown in B, figure 4-229.

(*b*) Adjust signal generator No. 2 output frequency to 705 MHz, measured on the frequency meter. On the unit under test, turn the XMTR DUPL control to XMTR CHANNEL 1010 and the RCVR SIG control to RCVR CHANNEL 910.

(*c*) Adjust the sweep generator SWEEP WIDTH and CENTER FREQUENCY controls to display the response curve only, on the oscilloscope.

(*d*) Adjust signal generator No. 2 output

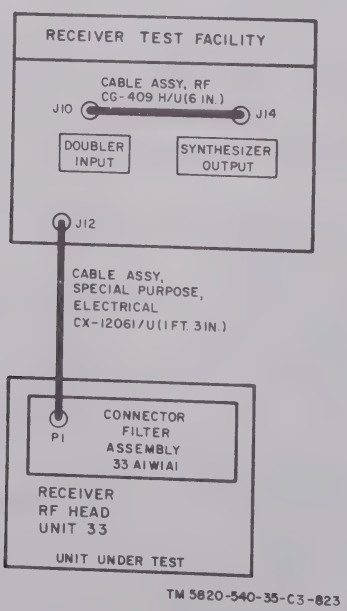

Figure 4-228. Receiver RF head, 33, alignment, test setup.

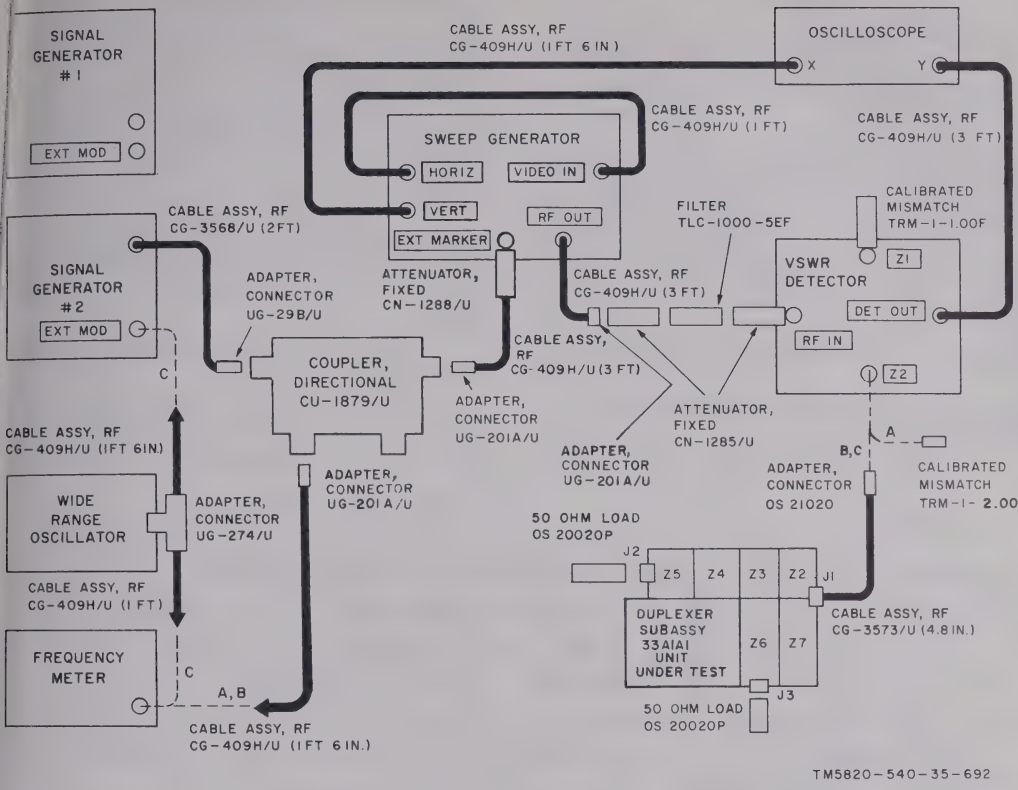

Figure 4-229. Duplexer 33A1A1 vswr and bandwidth, test setup.

evel for a suitable marker amplitude, viewed on he oscilloscope. Readjust the XMTR DUPL control to center the response on the 705-MHz marker.

(*e*) Connect the test equipment as shown n C, figure 4-229.

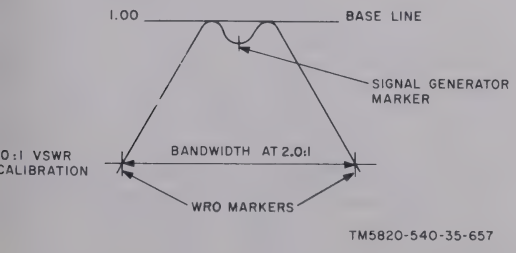

Figure 4-230. Duplexer assembly 33A1A1, typical vswr response.

(*f*) Adjust the wide range oscillator (wro) to place markers at the points where the response intersects the 2.0:1 vswr calibration line, as shown in figure 4-230. Note the wro frequency as indicated on the frequency meter.

(*g*) Multiply the wro frequency obtained in (*f*) above, by 2 to obtain the bandwidth. The bandwidth should be greater than 2.0 MHz.

(*h*) Repeat steps (*b*) to (*g*) above using the XMTR CHANNEL, RCVR CHANNEL and signal generator frequencies listed in the table below. The bandwidth at the 2.0:1 vswr line should be greater than 2 MHz.

XMTR CHANNEL	RCVR CHANNEL	Sig. gen. freq. (MHz)
980	880	690
800	700	600
420	520	410*
390	490	395*

*Use signal generator No. 1.

NOTE

Maintain a separation of at least 100 channels between RCVR CHANNEL and XMTR CHANNEL while performing step (*i*) below.

(*i*) Tune the XMTR CHANNEL from one extreme to the other and back again, simultaneously tuning the appropriate signal generator and the sweep generator center frequency to display the passband on the oscilloscope. The bandwidth at the 2.0:1 vswr line should be greater than 2 MHz.

(3) *Receiver filter vswr, bandwidth and backlash.*

(*a*) Connect the test equipment as shown in B, figure 4-229.

(*b*) Adjust signal generator No. 2 output frequency to 705 MHz, measured on the frequency meter. Turn the RCVR SIG control to RCVR CHANNEL 1010 and the XMTR DUPL control to XMTR CHANNEL 910.

(*c*) Adjust the sweep generator SWEEP WIDTH and CENTER FREQUENCY controls to display the response curve only on the oscilloscope.

(*d*) Adjust signal generator No. 2 output level for a suitable marker amplitude, viewed on the oscilloscope. Readjust the XMTR DUPL control to center the response on the 705-MHz marker.

(*e*) Connect the test equipment as shown in C, figure 4-229.

(*f*) Adjust the wro to place markers at the points where the response intersects the 2.0:1 vswr calibration line, as shown in figure 4-230.

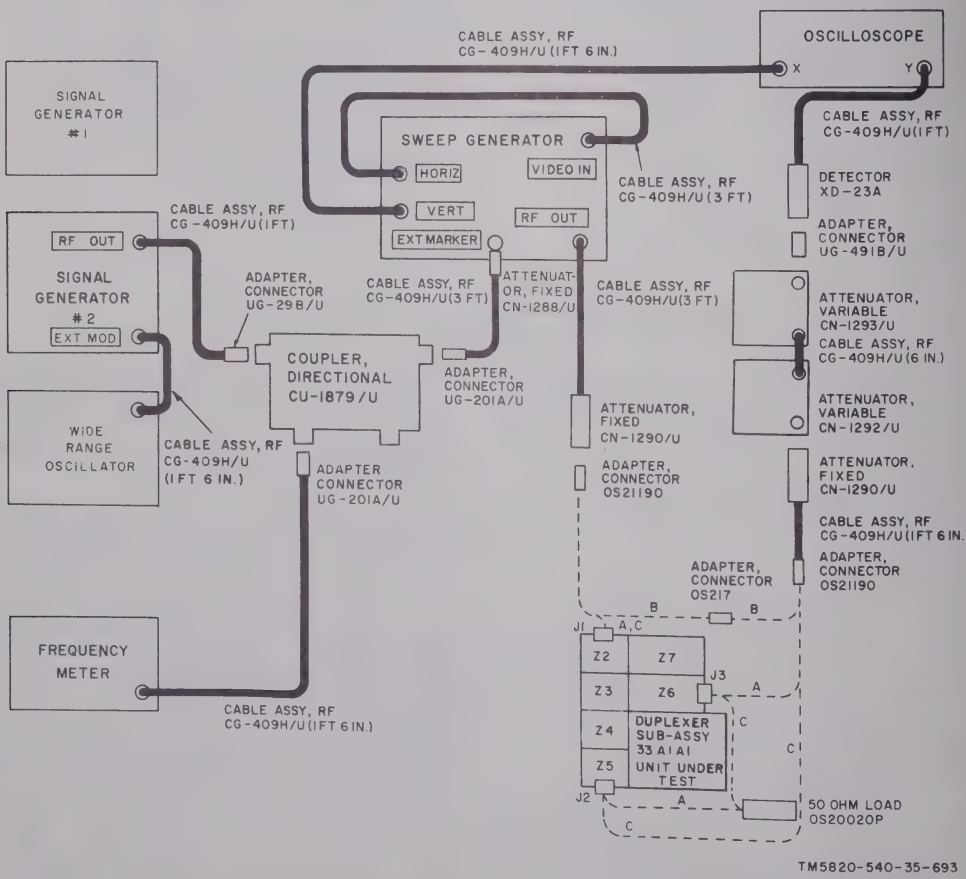

Figure 4-231. Duplexer 33A1A1 insertion loss, test setup.

Note the wro frequency as indicated on the frequency meter.

(*g*) Multiply the wro frequency obtained in step (*f*) above, by 2 to obtain the bandwidth. The bandwidth should be greater than 2.0 MHz.

(*h*) Repeat steps (*b*) to (*g*) above using the RCVR CHANNEL and signal generator frequencies given below. The bandwidth at the 2.0:1 vswr line should be greater than 2 MHz.

RCVR CHANNEL	XMTR CHANNEL	Sig. gen. freq. (MHz)
980	880	690
800	700	600
420	520	410*
390	490	395*

*Use signal generator No. 1.

NOTE

Maintain a separation of at least 100 channels between XMTR CHANNEL and RCVR CHANNEL while performing step (*i*) below.

(*i*) Tune the RCVR CHANNEL from one extreme to the other and back again, simultaneously tuning the appropriate signal generator and the sweep generator center frequency to display the passband on the oscilloscope. The bandwidth at the 2.0:1 vswr line should be greater than 2 MHz.

(4) *Transmitter filter insertion loss.*

(*a*) Set up the test equipment as shown in A, figure 4–231.

(*b*) Adjust signal generator No. 2 output frequency to 705 MHz, measured on the frequency meter. Turn the RCVR SIG control to RCVR CHANNEL 910 and the XMTR DUPL control to XMTR CHANNEL 1010.

(*c*) Set the sweep generator output attenuators to 0 db and adjust the SWEEP WIDTH and CENTER FREQUENCY controls to display the response curve only, on the oscilloscope.

(*d*) Adjust signal generator No. 2 output level for a suitable marker amplitude, viewed on the oscilloscope. Readjust the XMTR DUPL control to center the response on the 705-MHz marker.

(*e*) Set the variable attenuators to 0 db and note the response amplitude at the center frequency.

(*f*) Connect the test equipment as shown in B, figure 4–231.

(*g*) Adjust the variable attenuators to return the response amplitude to the amplitude noted in step (*e*) above. The attenuation increase should be no greater than 2 db.

(*h*) Connect the test equipment as shown in A, figure 4–231.

(*i*) Adjust signal generator No. 1 output frequency to 395 MHz, measured on the frequency meter. Turn the RCVR SIG control to RCVR CHANNEL 490 and the XMTR DUPL control to XMTR CHANNEL 390.

(*j*) Adjust signal generator No. 1 output level for a suitable marker amplitude, viewed on the oscilloscope. Readjust the XMTR DUPL control to center the response on the 395-MHz marker.

(*k*) Set the variable attenuators to 0 db and note the response amplitude at the center frequency.

(*l*) Not used.

(*m*) Connect the test equipment as shown in B, figure 4–231.

(*n*) Adjust the variable attenuators to return the response amplitude to the amplitude noted in step (*k*) above. The attenuation increase should be no greater than 2 db.

(5) *Receiver filter insertion loss.*

(*a*) Set up the test equipment as shown in C, figure 4–231.

(*b*) Adjust signal generator No. 2 output frequency to 705 MHz, measured on the frequency meter. Turn the RCVR SIG control to RCVR CHANNEL 1010 and the XMTR DUPL control to XMTR CHANNEL 910.

(*c*) Set the sweep generator output attenuators to 0 db and adjust the SWEEP WIDTH and CENTER FREQUENCY controls to display the response curve only, on the oscilloscope.

(*d*) Adjust signal generator No. 2 output level for a suitable marker amplitude, viewed on the oscilloscope. Readjust the RCVR SIG control to center the response on the 705-MHz marker.

(*e*) Set the variable attenuators to 0 db and note the response amplitude at the center frequency.

(*f*) Connect the test equipment as shown in B, figure 4–231.

(*g*) Adjust the variable attenuators to return the response amplitude to the amplitude noted in step (*e*) above. The attenuation increase should be no greater than 2.5 db.

(*h*) Connect the test equipment as shown in C, figure 4–231.

(*i*) Adjust signal generator No. 1 output frequency to 395 MHz, measured on the frequency meter. Turn the RCVR SIG control to RCVR CHANNEL 390 and the XMTR DUPL control to XMTR CHANNEL 490.

(*j*) Adjust signal generator No. 1 output level for a suitable marker amplitude, viewed on the oscilloscope. Readjust the RCVR SIG control to center the response on the 395-MHz marker.

(*k*) Set the variable attenuators to 0 db and note the response amplitude at the center frequency.

(*l*) Not used.

(*m*) Connect the test equipment as shown in B, figure 4–231.

(*n*) Adjust the variable attenuators to return the response amplitude to the amplitude noted in step (*k*) above. The attenuation should be no greater than 2 db.

(6) *RCVR SIG alignment check.*

(*a*) Connect the test equipment as shown in B, figure 4–229. Leave the EXT MARKER cable disconnected.

(*b*) Turn the RCVR SIG control to channel 1010 and turn the XMTR DUPL control fully counterclockwise.

(*c*) Reset the sweep generator to 705 MHz.

(*d*) With the aid of the markers adjust the RCVR SIG control until the maximum amplitude of the response is tuned precisely to 705 MHz.

(*e*) Check to see that channel number 1010 is not more than ⅛ inch above or below the calibration mark (centerline of RCVR CHANNEL window).

(*f*) Check the alignment of the tape every 20 channels down to channel 389. Check to see that the indicated channel and frequency are in the following relationship:

$$\text{Channel number} = 2(\text{Frequency (MHz)} - 200)$$

$$\text{Frequency (MHz)} = \frac{\text{Channel number}}{2} + 200$$

(7) *XMTR DUPL alignment check.*

(*a*) Connect the test equipment as shown in B, figure 4–229. Leave the EXT MARKER cable disconnected.

(*b*) Turn the XMTR DUPL control to channel 1010 and the RCVR SIG control fully counterclockwise.

(*c*) Reset the sweep generator to 705 MHz.

(*d*) With the aid of the markers adjust the XMTR DUPL control until the maximum amplitude of the response is tuned precisely to 705 MHz.

(*e*) Check to see that the channel number 1010 is not more than ⅛ inch above or below the calibration mark (centerline of XMTR CHANNEL window).

(*f*) Check the alignment of the tape every 20 channels as described in (6) (*f*) above.

(*g*) If the tape requires adjustment refer to paragraph 4–148*c*.

4–121. Connector-Filter Assembly 33A1W1A1

a. Test Equipment and Material Required.

Equipment	Common name
Multimeter TS-352B/U	Multimeter

b. Test Procedure. This assembly comprises plugs 33A1W1A1P1, 33A1W1A1P2 and 33A1W1A1J2 (figs. 3–49 and 3–56). Check each circuit as follows (fig. 7–7):

(1) Check continuity between each pin of 33A1W1A1P1 and its associated filter connector and between RF connectors A1 and A2 of 33A1W1A1P1 and 33A1W1A1P2 and 33A1W1A1J2.

(2) Check for short circuits between all pins and center conductors of RF connectors and ground.

c. Repairs.

(1) The RF connectors in 33A1W1A1P1 can be replaced as follows:

(*a*) Force the RF connectors back into the connector-filter assembly.

(*b*) Slide the insulating sleeve back along the cable and unsolder the faulty connector.

(*c*) Install the new connector on the RF cable (para 4–10).

(*d*) Push the new connector into the mounting hole in 34A1W1A1P1 until the retaining springs snap into place, holding the connector firmly.

(2) If 33A1W1A1P1, 33A1W1A1P2 or 33A1W1A1J2 are damaged beyond repair, refer to paragraph 4–156 for replacement procedures.

4–122. Frequency Multiplier Group 33A2

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Generator, Sweep SG–888	Sweep generator
Oscilloscope AN/USM–281	Oscilloscope
Generator, Signal SG–409( )/U.	Signal generator No. 1
Generator, Signal SG–340A/G.	Signal generator No. 2
Frequency Meter AN/USM–159.	Frequency meter
Wattmeter AN/URM–98	Power meter
Trombone Line General Radio 874–LTL.	Trombone line 874–LTL
Wide Band RF Amplifier Test Jig SAC–SK–012.	Test jig
Adapter-Connector 874–QNJA (2 required).	
Cable Assembly, Special Purpose Electrical, SAC–SK–014.	
Adapter-Connector Omni Spectra 21180.	Adapter-connector OS21180
Adapter-Connector Omni Spectra 21020.	Adapter-connector OS21020
Adapter-Connector Omni Spectra 21010.	Adapter-connector OS21010
Adapter-Connector UG–107B/U.	

b. Test Procedures.

(1) *Input vswr check.*

(*a*) Connect the test equipment as shown in A, figure 4–232.

(*b*) Adjust the sweep generator controls to provide a 97.5-MHz cw signal at an input level to the unit under test of +17 dbm (+7 dbm power meter reading).

(*c*) Connect the test equipment as shown in B, figure 4–232.

(*d*) Set receiver test facility switches S1 to ON and S6 away from the OFF position, apply power to the test jig.

(*e*) Record the power meter indication.

(*f*) Reverse the input and output connections of the bidirectional coupler (the secondary port remains connected to the power meter). The

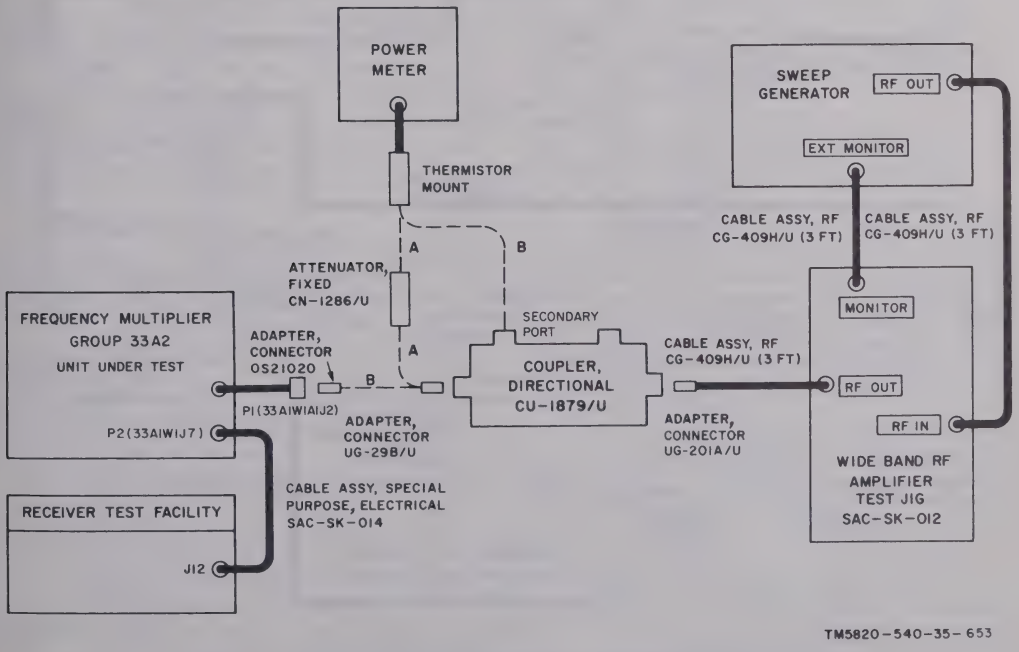

Figure 4–232. Frequency multiplier group 33A2 input vswr check, test setup.

power level (reflected power) must be at least 11.3 db lower than that recorded in step (*e*) above. This represents a vswr of better than 1.75:1.

(*g*) Repeat steps (*c*), (*e*), and (*f*) above for sweep generator frequencies of 100, 110, 120, 130 and 145 MHz.

(*h*) Connect the test equipment as shown in A, figure 4–232.

(*i*) Adjust the sweep generator controls to provide a 97.5-MHz cw signal at an input level to the unit under test of +13 dbm (+3 dbm indication on the power meter).

(*j*) Repeat steps (*c*), (*e*), and (*f*) above for sweep generator frequencies of 100, 110, 120, 130 and 145 MHz.

(2) *Output check.*

(*a*) Connect the test equipment as shown in A, figure 4–233.

(*b*) Set receiver test facility switches S1 to ON and S6 away from the OFF position.

(*c*) Adjust the sweep generator controls to provide a sweep between 106 and 140 MHz at an input level to the unit under test of +17 dbm (+4 dbm power meter reading).

(*d*) Connect the test equipment as shown in B, figure 4–233.

(*e*) Adjust shaft C (fig. 4–234) until the marks on the bandpass filter and frequency multiplier gears B and D are in line with their corresponding marks on the casting.

(*f*) Adjust the oscilloscope controls for a convenient display.

(*g*) Simultaneously tune shaft C of the unit under test and the appropriate signal generator (used as a marker generator) from 425 to 735 MHz. Record the output frequency of lowest

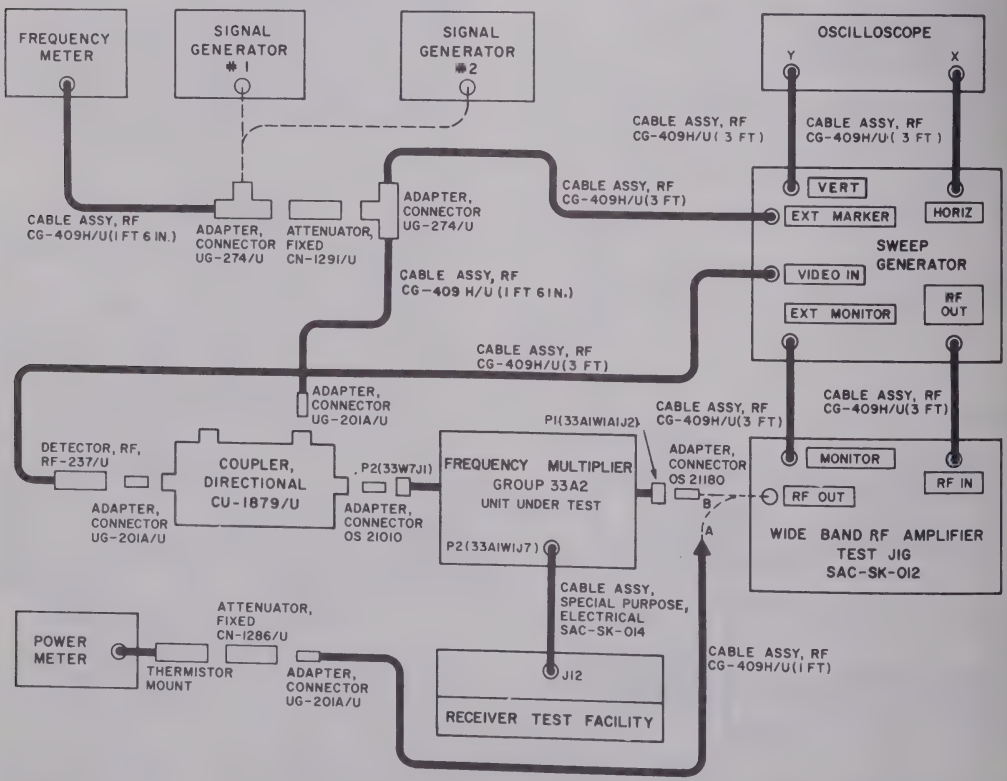

Figure 4–233. Frequency multiplier group 33A2 output check and tracking alignment test setup.

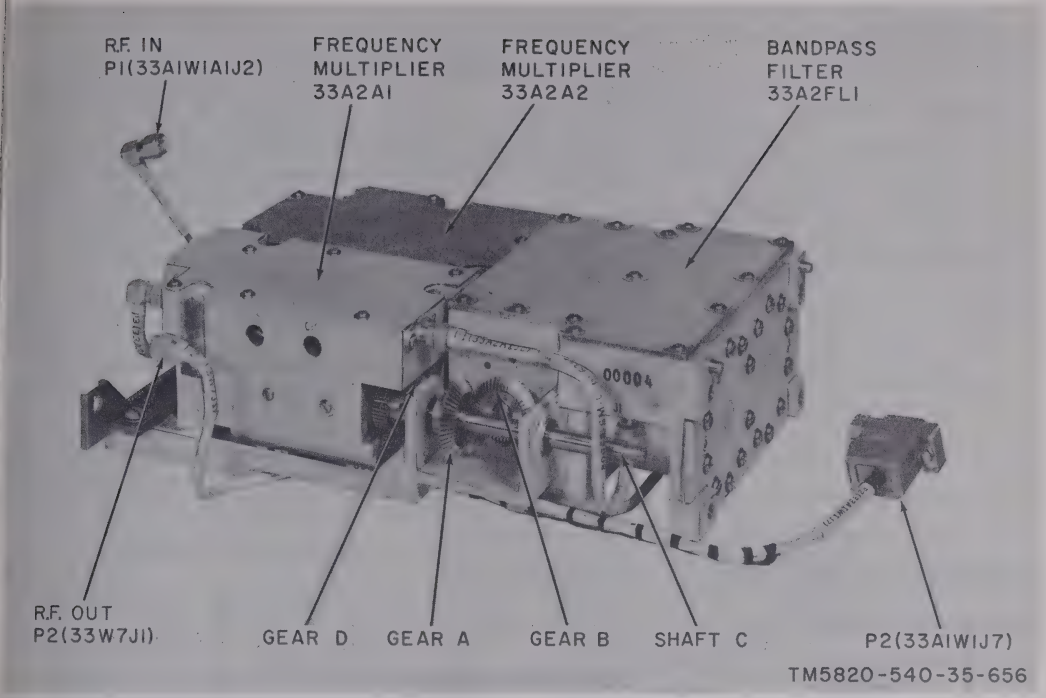

Figure 4-234. Frequency multiplier group 33A2, top view.

power level as displayed on the oscilloscope. Determine the corresponding input frequency by dividing the signal generator frequency by four for frequencies of 580 MHz and below, and by six for frequencies of 580 MHz and above.

NOTE

A marker will appear only when there is an output at that frequency.

(*h*) Connect the test equipment as shown in figure 4-235.

(*i*) Tune the appropriate signal (marker) generator to the output frequency of lowest power as recorded in step (*g*) above.

(*j*) Adjust the sweep generator controls to provide the corresponding input frequency with a sweep width of 20 MHz.

(*k*) Tune the unit under test, by means of shaft C (fig. 4-234), for a peak response on the oscilloscope at the external marker frequency.

(*l*) Not used.

(*m*) Adjust the sweep generator sweep width to minimum maintaining the external marker on display by fine tuning the sweep generator center frequency.

(*n*) Adjust the trombone line for a minimum indication on the power meter. The power output must be at least +6.5 dbm (—3.5 dbm power meter reading).

(*o*) Repeat step (*n*) above for an input level to the unit under test of +13 dbm (0 dbm meter reading).

c. Troubleshooting (fig. 7-6).

Symptom	Probable cause	Checks and corrective measures
1. High vswr	Defective frequency multiplier 33A2A2 (fig. 4-234).	Replace frequency multiplier 33A2A2 (para 3-94) and test defective unit as shown in paragraph 4-124.

Symptom	Probable cause	Checks and corrective measures
2. Power output low or zero	*a.* Defective frequency multiplier 33A2A2.	*a.* Disconnect P2 (33A2AJ1) from J1 of the frequency multiplier 33A2A2 (fig. 3-49) and connect the power meter to J1. Power meter should indicate −5 dbm ±2 db. If output is abnormal, replace frequency multiplier 33A2A2 (para 3-94) and test defective unit as shown in para 4-124.
	b. Defective variable frequency multiplier 33A2A1.	*b.* If power at J1 is normal, reconnect J1 to P2. Disconnect P1 (33A2A1J2) from J2 of frequency multiplier 33A2A1 and connect the power meter to J2. Power meter should indicate at least −3 dbm. If output is abnormal, replace frequency multiplier 33A2A1 (para 4-153) and test defective unit as shown in para 4-123.
	c. Defective bandpass filter 33A2FL1.	*c.* If power at J2 of the frequency multiplier (33A2A1) is normal, test bandpass filter 33A2FL1 as shown in para 4-127.
	d. Misalignment	*d.* If misalignment is suspected refer to *d* below for complete alignment procedures.

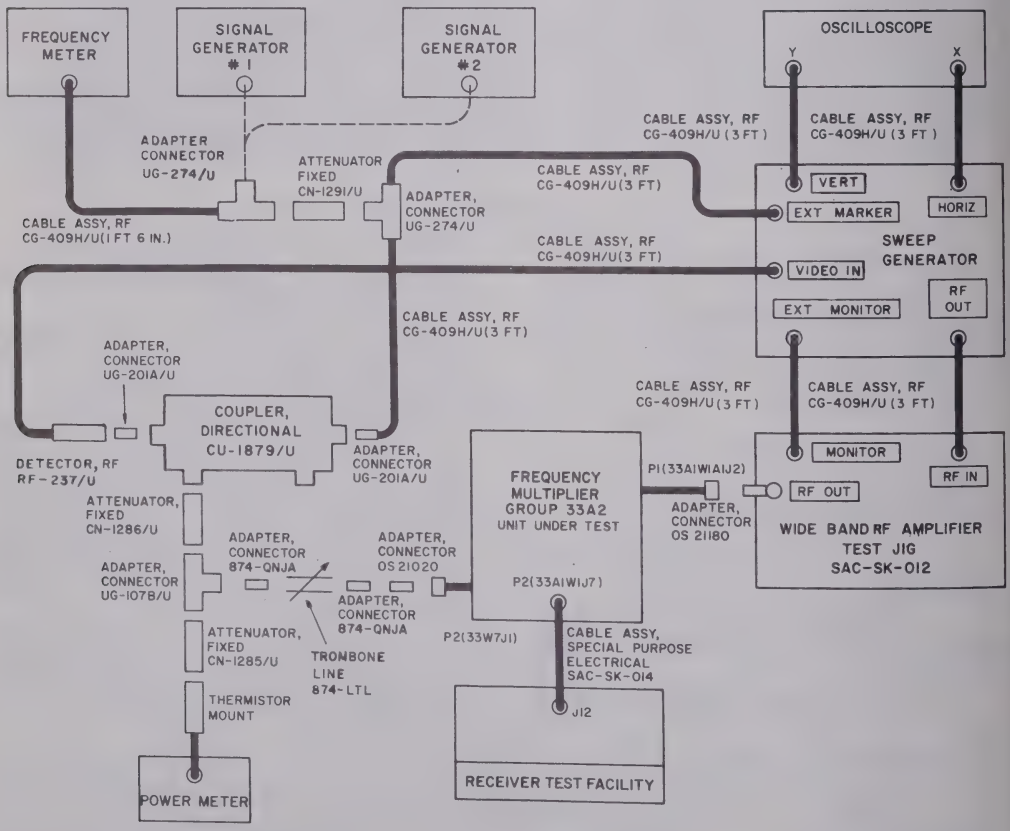

Figure 4-235. Frequency multiplier group 33A2 output check, test setp.

d. Tracking Alignment.

(1) Turn shaft C (fig. 4–234) until the mark n bevel gear B coincides with the mark on the asting.

(2) Loosen the setscrews on gear A and otate shaft C until the mark on gear D coincides vith the corresponding mark on the casting.

(3) Connect the test equipment as shown in A, figure 4–233.

(4) Set receiver test facility switches S1 to ON and S6 away from OFF.

(5) Tune signal generator No. 1 to 425 MHz as indicated on the frequency meter.

(6) Adjust the sweep generator controls to provide a sweep between 100 and 110 MHz with an input level to the unit under test of +15 dbm (±2 dbm as indicated on the power meter).

(7) Connect the test equipment as shown in B, figure 4–233.

(8) Adjust the oscilloscope controls for a convenient display.

(9) Tune the bandpass filter FL1, by turning bevel gear B (fig. 4–234), for maximum response at 425 MHz.

(10) Turn shaft C to adjust the frequency multiplier A1 for maximum response at 425 MHz.

(11) Tighten the setscrews on gear A.

NOTE

When tightening the bevel gear take care to adjust for minimum backlash.

(12) Adjust the sweep generator controls to provide a sweep between 95 and 145 MHz.

(13) Slowly tune the unit under test with shaft C and monitor the oscilloscope display with markers from the appropriate signal generator, throughout the frequency range of 425 to 735 MHz. The changes in amplitude must be smooth and not abrupt or irregular.

(14) If the requirements of step (13) above cannot be met slacken the setscrews on gear A and slightly detune the bandpass filter. Retighten the setscrews and repeat step (13) above.

4–123. Frequency Multiplier 33A2A1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Frequency Meter AN/USM–159.	Frequency meter
Generator, Signal SG–409( )/U.	Signal generator No. 1
Generator, Signal SG–340A/G.	Signal generator No. 2
Wattmeter AN/URM–98	Power meter
Sweep Generator SG–888	Sweep generator
Generator, Signal AN/USM–205.	Wide range oscillator
Oscilloscope AN/USM–281	Oscilloscope
Trombone Line General Radio 874–LTL.	Trombone line 874–LTL
Adapter-Connector UG–107B/U.	
Adapter-Connector 874–QNJA (2 required).	
Adapter-Connector Omni Spectra 21020.	Adapter-connector OS21020
Adapter-Connector Omni Spectra 21190 (2 required).	Adapter-connector OS21190
Dummy Load Telonic TRM–1–1.60F.	Calibrated mismatch TRM–1–1.60F.
Band II Receiver Multiplier Tuning Law Test Jig SM–D–696026.	Tuning law test jig
Wide Band RF Amplier Test Jig SAC–SK–012.	Test jig
Cable Assembly, Special Purpose Electrical, SAC–SK–014.	
Attenuator Variable Weinschel 905.	Variable attenuator No. 3
Voltmeter, Electronic ME–247/U.	RF voltmeter
Multimeter TS–352/U	Multimeter

b. Test Procedures.

(1) *Input vswr check.*

(*a*) Connect the test equipment as shown in A, figure 4–236.

(*b*) Set the sweep generator controls to sweep the frequency range 190 to 290 MHz.

(*c*) Set the sweep generator output level controls for a level of +14 dbm at RF OUT of the test jig (+4 dbm as indicated on the power meter).

(*d*) Connect the test equipment as shown in B, figure 4–236.

(*e*) Calibrate the oscilloscope for a vswr of 1.6:1 between 190 and 290 MHz.

(*f*) Connect the test equipment as shown in C, figure 4–236.

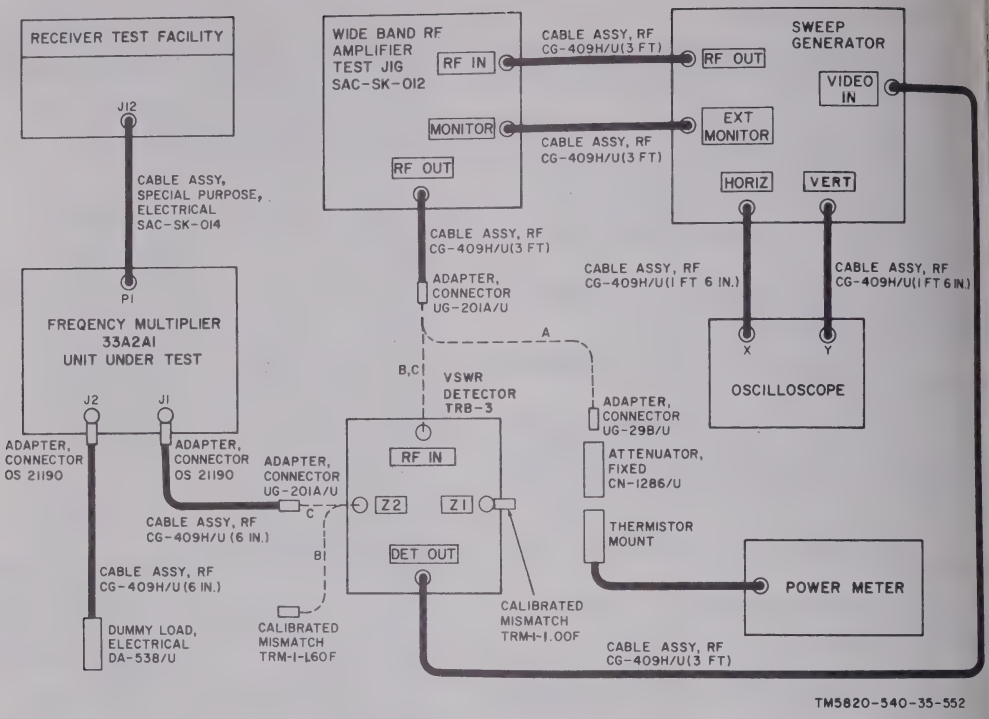

Figure 4-236. Frequency multiplier 33A2A1 input vswr check, test setup.

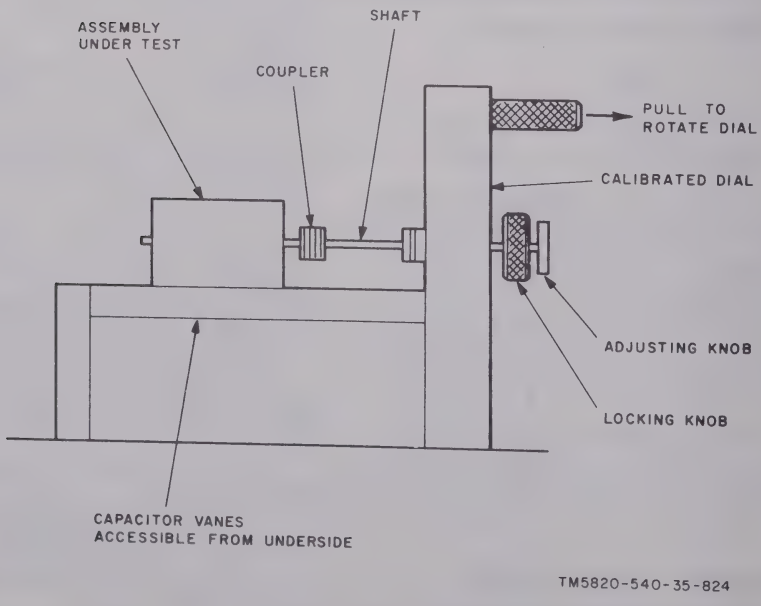

Figure 4-236.1 Frequency multiplier 33A2A1 tuning law test jig.

(*g*) Adjust C1 and L1 (fig. 4–238) on unit under test for minimum power over the frequency range. Vswr of the unit under test should not exceed 1.6:1.

(2) *Tuning law.*

(*a*) Set up the equipment as follows:

1. Loosen the locking knob (fig. 4–236.1) on the tuning law test jig so that the shaft can be rotated independently of the calibrated dial.

2. Place the assembly under test on the tuning law test jig and engage the shaft of the variable capacitor with the test jig coupler.

3. Tighten the allen screws in the coupler. Secure the unit under test to the test jig using the three mounting screws in the unit.

4. Pull the handle in the calibrated dial and rotate the dial until 425 coincides with the white index mark. Release the handle and insure that the dial locks in the detent at 425.

(*b*) Connect the test equipment as shown in A, figure 4–237. Set variable attenuators No. 1 and No. 2 to 0 db and No. 3 to MIN. Set the oscilloscope display selector to channel B.

(*c*) Set the sweep generator to 212.5 MHz

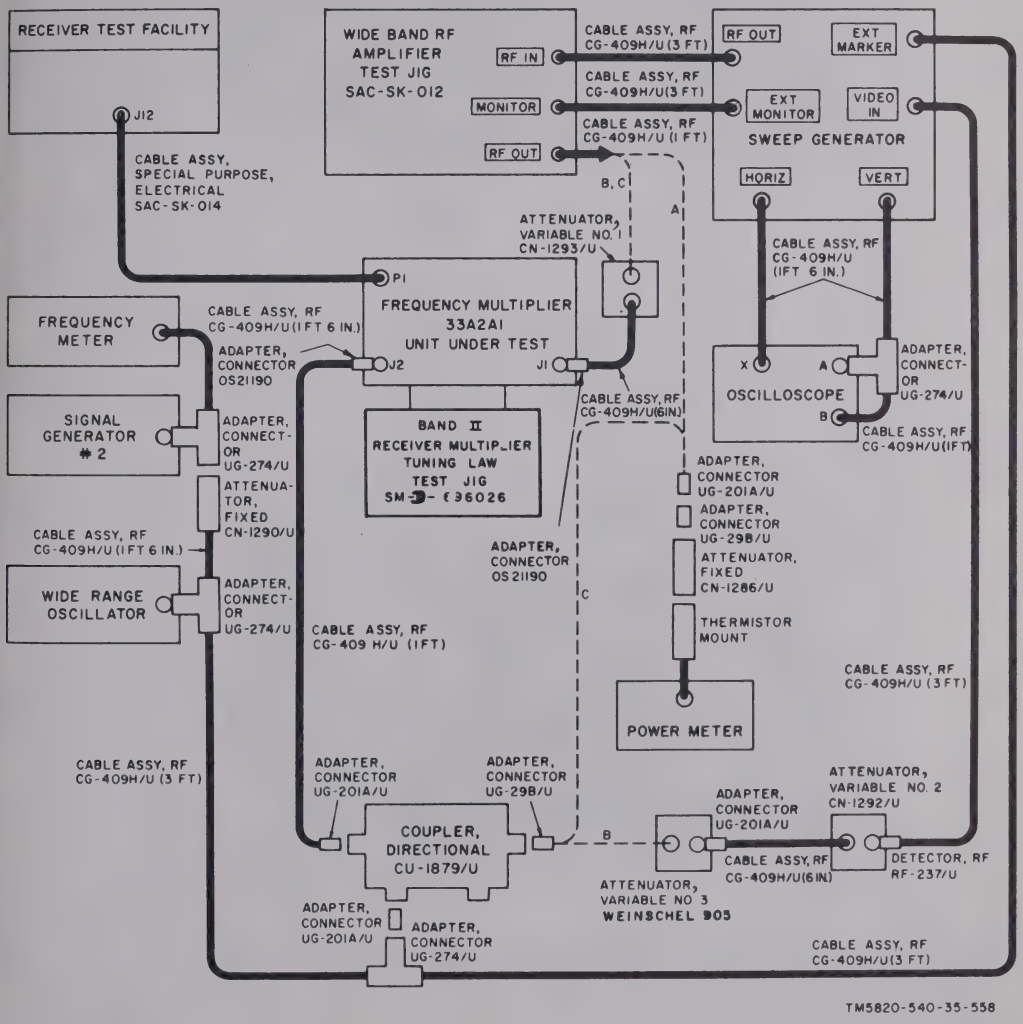

Figure 4–237. Frequency multiplier 33A2A1 tuning law, test setup.

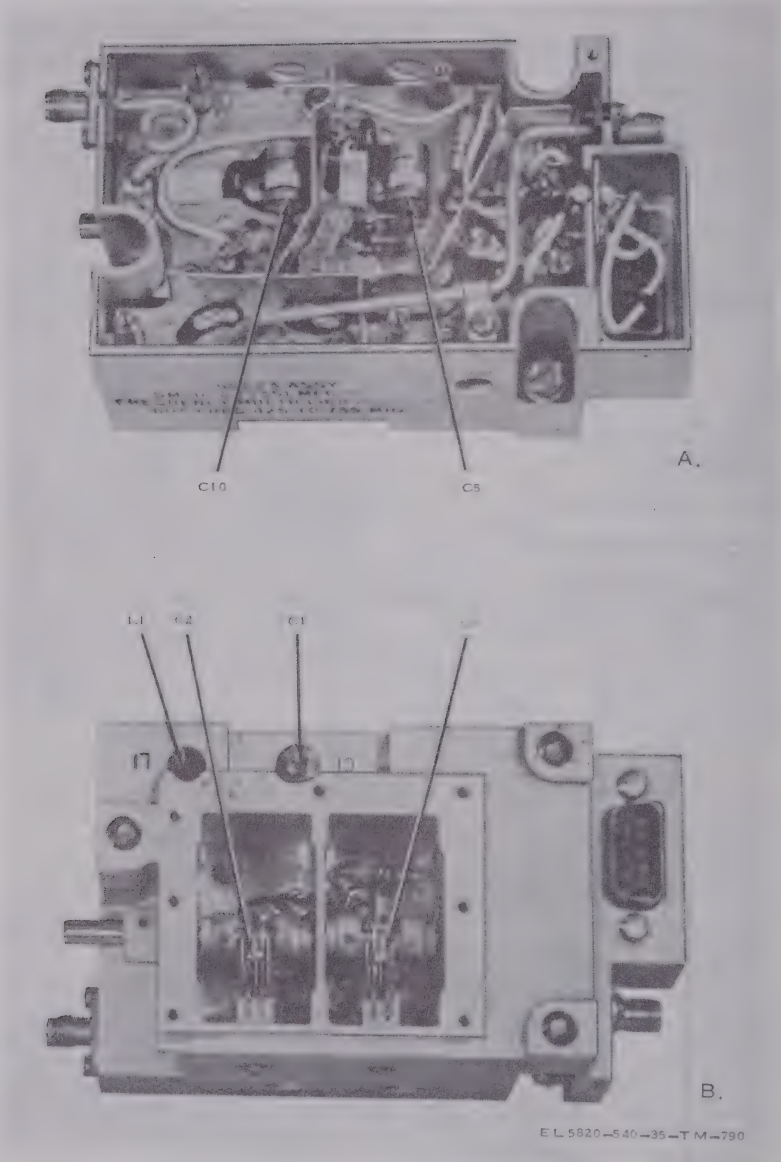

Figure 4-238. Frequency multiplier 33A2A1 top and bottom view.

vith a sweep width of approximately 5 MHz at a evel of +16 dbm at the wide band RF amplifier est jig output (+6 dbm as indicated on the ower meter).

NOTE

Do not alter sweep generator level controls during the following tests.

(*d*) Connect the test equipment as shown n B, figure 4–237. Set variable attenuator No. 1 o 2 db.

(*e*) Using the adjusting knob on the tuning law test jig, adjust the variable capacitor C2 and C3 (fig. 4–238) on the unit under test for maximum capacitance as determined visually (capacitor blades fully meshed).

(*f*) Adjust the oscilloscope controls to disply the response curve.

(*g*) Adjust the variable capacitors C2 and C3 on the unit under test for maximum capacitance as determined by the display on the oscilloscope. Maximum capacitance is indicated by maximum horizontal displacement of the response curve to the left of the oscilloscope face.

(*h*) Hold the variable capacitors at maximum capacitance and tighten the tuning law test jig locking knob so that the variable capacitors on the unit under test will turn with the calibrated dial.

(*i*) Swing the dial back and forth about the 425 position, checking that maximum displacement of the display to the left of the oscilloscope face coincides with 425 on the calibrated dial.

(*j*) Set the tuning law test jig calibrated dial to 735 and signal generator No. 2 to 735 MHz.

(*k*) Set the sweep generator center frequency to 245 MHz and adjust C2, C5 and C10 on the unit under test for maximum amplitude of the response curve at 735 MHz.

(*l*) Not used.

(*m*) Connect the test equipment as shown in C, figure 4–237.

(*n*) Set the sweep generator sweep width to minimum and adjust variable attenuator No. 1 for an indication of —3.5 dbm on the power meter (+6.5 dbm at detector input). If necessary slightly detune sweep generator frequency to obtain exact level of —3.5 dbm.

(*o*) Connect the test equipment as shown in B, figure 4–237.

(*p*) Set the oscilloscope display selector to ALT and adjust channel A sensitivity controls to obtain response amplitude of 6 cm. Adjust sweep generator sweep width for a suitable response. Mark the peak response on the oscilloscope graticule. This is the +6.5 dbm calibration line (A, fig. 4–238.1).

(*q*) Set the oscilloscope vertical sensitivity to 0.05 VOLTS/CM and disregarding baseline adjust vertical position to place channel B response peak level with that of channel A (A, fig. 4–238.1).

(*r*) Set the variable attenuator No. 2 to 0.4 db and mark the channel B response level on the oscilloscope graticule. This is the +6.1 dbm calibration line.

(*s*) Set variable attenuators No. 1 and No. 2 to 2 db and 0 db respectively. Retune sweep generator frequency to 245 MHz.

(*t*) Adjust variable attenuator No. 3 to make oscilloscope channel A response amplitude 6 cm. The 1 MHz markers on the channel B response should not be above the +6.1 dbm calibration line (A and B, fig. 4–238.1).

(*u*) Repeat step (*t*) above for the sweep and signal generator frequencies and tuning law test jig calibrated dial positions listed below. At each frequency channel A response should not be less than the +6.5 dbm calibration line. Do not readjust channel A or B sensitivity controls.

Sweep generator frequency	Tuning law test jig and signal generator No. 2 frequency
735	245.0
707	235.66
674	224.66
645	215.0
618	206.0
595	198.33
575	287.5
556	278.0
538	269.0
522	261.0
507	253.5
493	246.5
481	240.5
470	235.0
459	229.5
449	224.5
439	219.5
425	212.5

(*v*) Set signal generator No. 2 to 580 MHz, sweep generator center frequency to 193.3 MHz, and the oscilloscope display to channel B.

(*w*) Set the tuning law test jig calibrated dial to 580. As there is no detent for this frequency, adjust the dial for peak response on the

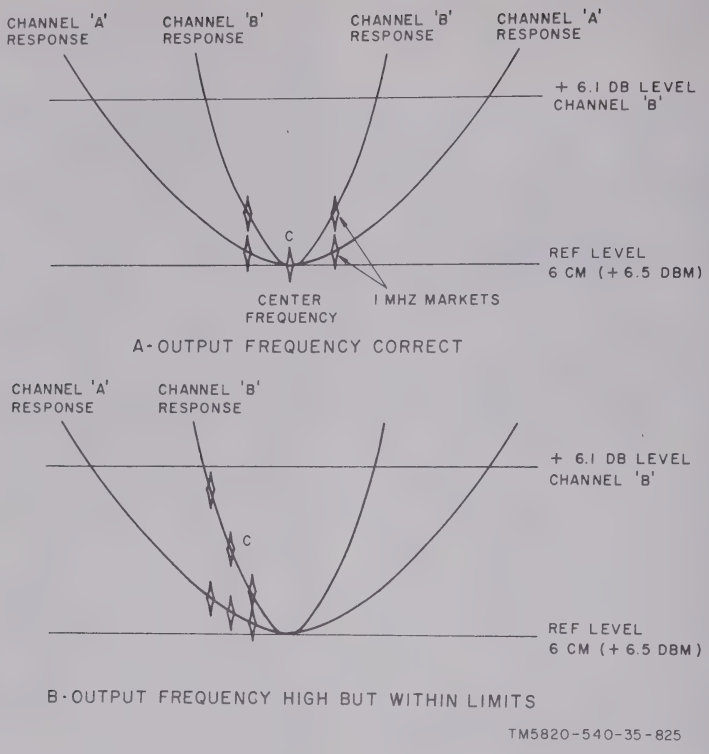

Figure 4-238.1 Frequency multiplier 33A2A1, tracking waveforms.

580-MHz marker. Note the shape of the response.

(*x*) Set the sweep generator center frequency to 290 MHz. The response curve should be exactly the same as in (*w*) above.

(*y*) If multiplier misalignment is suspected, refer to *c* below for alignment procedure.

(3) *Bandwidth.*

(*a*) Connect the test equipment as shown in A, figure 4-237 and set variable attenuators No. 1 and No. 2 to 0 db and No. 3 to MIN.

(*b*) Set the sweep generator to 245 MHz with a sweep width of 25 MHz approximately at a level of +14 dbm at the input of the unit under test (+4 dbm as indicated on the power meter).

(*c*) Connect the test equipment as shown in B, figure 4-237.

(*d*) Set the tuning law test jig to 735.

(*e*) Adjust the oscilloscope for a suitable display and mark the response peak on the oscilloscope face.

(*f*) Set variable attenuator No. 2 to 3 db and mark the new level as the nominal —3 db level.

(*g*) Reset variable attenuator No. 2 to 0 db.

(*h*) Set signal generator No. 2 to 735 MHz.

(*i*) Set the wide range oscillator frequency to produce markers at the intersection of the response curve and the —3 db line. Bandwidth at the —3 db level is twice the wide range oscillator frequency and must be between 7.5 MHz and 52 MHz.

(*j*) Repeat (*b*) through (*h*) above for frequencies shown below.

Sweep gen center freq (MHz)	Test jig setting and sig gen No. 2 freq (MHz)	Bandwidth (MHz)	
		minimum	maximum
206	618	6.1	43.3
287.5	575	5.7	40.3
278	556	5.5	39.9
212.5	425	4.2	29.8

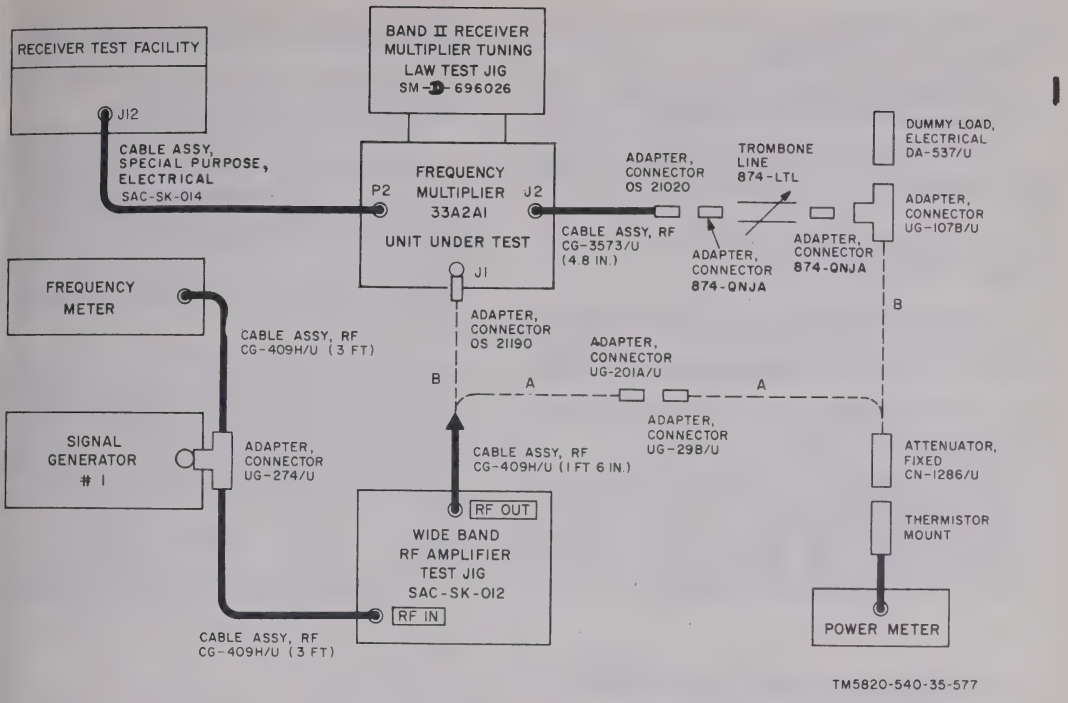

Figure 4–239. Frequency multiplier 33A2A1 output power check, test setup.

(4) *Output power.*

(*a*) Connect the test equipment as shown in A, figure 4–239.

(*b*) Set signal generator No. 1 to 245 MHz at a level of +12 dbm at the input to the unit under test (+2 dbm as indicated on the power meter).

(*c*) Connect the test equipment as shown in B, figure 4–239.

(*d*) Set the tuning law test jig to 735.

(*e*) Adjust the trombone line for the lowest reading on the power meter. Level should be not less than —7 dbm.

(*f*) Repeat (*a*) through (*e*) above with a level of +16 dbm (+6 dbm as indicated on the power meter) at the input to the unit under test.

(*g*) Repeat (*a*) through (*f*) above at the signal generator No. 1 frequencies listed below.

Sig gen No. 1 frequency (MHz)	Test jig setting
24.66	674
06.00	618
87.50	575
53.50	507
29.50	459
12.50	425

Output level for all frequencies must be not less than —7 dbm.

c. Alignment.

(1) Perform steps (*b*) through (*k*) of the tuning law check in *b*(2) above. Pull out the calibrated dial handle and rotate the dial about the 735 position. Maximum response should occur at the 735 position. If necessary, loosen the tuning law test jig locking knob and tune the adjusting knob to meet this requirement. Retighten the locking knob.

(2) Set signal generator No. 2 to 674 MHz.

(3) Set the tuning law test jig dial to 674.

NOTE

The rotor of variable capacitors C2 and C3 (fig. 4–238) consists of three blades. The center blade is fixed while the two outside blades are split into a number of sections. To adjust the capacitors, those sections of the split blades that are meshed with the stator are bent as required.

(4) Adjust variable capacitors C2 and C3 for

maximum amplitude and to center the peak of the response curve at 674 MHz.

(5) Return the tuning law test jig dial to 735 and signal generator No. 2 to 735 MHz.

(6) Readjust capacitors C2 and C3 for maximum amplitude and response centering at 735 MHz.

(7) Repeat (2) through (7) above for best results at both frequencies.

(8) Set the tuning law test jig dial to 618 and signal generator No. 2 to 618 MHz and adjust the capacitor blades for optimum results at 618 MHz.

(9) Recheck the response at 674 MHz and readjust the capacitor blades if necessary.

(10) Continue in this manner for every second frequency shown in the table in *b*(2)(*u*) above, adjusting for optimum results between the new frequency and the previous frequency checked, until every second frequency has been checked and the required adjustments have bee made.

(11) Return the tuning law test jig an signal generator No. 2 to 735 MHz.

(12) Check the response at every frequenc shown in the table. Little or no adjustment should be required for the remaining frequencies However, if adjustments are required for a give frequency, the remaining frequencies will b affected to some extent and therefore, all othe frequencies must be rechecked and adjustment made where necessary.

(13) Set the tuning law test jig dial to 42 and lock the dial in this position. Mark the whit gear wheel and the unit housing with red paint a approximately the 12 o'clock position. This wil permit the 425 MHz output frequency position o the unit under test to be easily determined.

NOTE

Do not mark the teeth of the gear wheel.

d. Troubleshooting (figs. 7–11 and 4–240).

Symptom	Checks and corrective measures
1. High vswr	Check the resistance of Q1 and components in Q1 base circuit and replace as required.
2. No output indication	*a.* Check the dc voltages as established in *e* below.
	b. Check the RF signal path using the allocated RF voltmeter. Refer to table below for typical indications. Check component in isolated stage and replace as required.
	c. Check for shorted plates on variable ganged capacitors C2 and C3 (fig. 4–238).
	d. Check connectors and cables for damage and wiring for continuity. Repair or replace as required.
3. Low output	Check the gain of transistor stages Q1, Q2 and Q3 using allocated RF voltmeter. Refer to table below for typical indications. Replace components in isolated stage as required.

Test Points	Typical Indication (volts rms)
33A2A1A1Q1—base	0.48V
—collector	130 mV
33A2A1A1Q2—base	14 mV
—collector	50 mV
33A2A1A1Q3—base	13 mV
—collector	50 mV

. Voltage and Resistance Measurements (fig. 4-240).

NOTE

Use the allocated multimeter for voltage and resistance measurements.

(1) *DC voltage measurements referenced to ground.*

Test points	Typical indication (volts dc)
33A2A1A1Q1—base	−6.3
—emitter	−6.3
33A2A1A1Q2—base	+0.62
—collector	+5.4
33A2A1A1Q3—base	+0.62
—collector	+5.5

(2) *Transistor resistance measurements.*

NOTE

All resistance measured with the allocated multimeter.

Stage	Transistor		Base(−)				Base(+)			
			Emitter(+)		Collector(+)		Emitter(−)		Collector(−)	
	Ref.	Type	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range
	Q1	2N2857	465	Rx 100	3100	Rx 100	465	Rx 100	1050	Rx 100
	Q2	2N2857	1050	Rx 100	800	Rx 100	975	Rx 100	800	Rx 100
	Q3	2N2857	830	Rx 100	1000	Rx 100	830	Rx 100	890	Rx 100

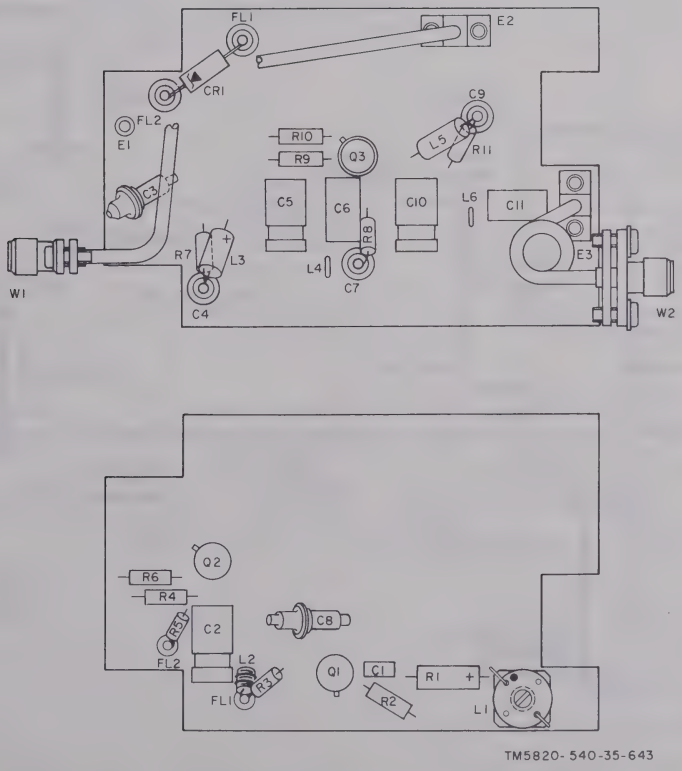

Figure 4-240. Frequency multiplier 33A2A1A2, parts location.

4–124. Frequency Multiplier 33A2A2 or 34A2A2

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Generator, Sweep SG–888	Sweep generator
Oscilloscope AN/USM–281	Oscilloscope
Wattmeter AN/URM–98	Power meter
Tunable Bandpass Filter Telonic TTF–500–5–3EE.	Tunable filter 375 to 750 MHz.
Trombone Line General Radio 874–LTL.	Trombone line 874–LTL
Wide Band RF Amplifier Test Jig SAC–SK–012.	Test jig
Cable Assembly, Special Purpose, Electrical SAC–SK–009.	
Adapter-Connector 874–QNJA (2 required).	
Adapter-Connector Omni Spectra 21020.	Adapter-connector OS21020
Adapter-Connector Omni Spectra 21170.	Adapter-connector OS21170
Adapter-Connector UG–107B/U.	
Adapter-Connector UG–57B/U.	
Adapter-Connector Omni Spectra 21010.	Adapter-connector OS21010
Voltmeter, Electronic ME–247/U.	RF voltmeter
Multimeter TS–352B/U	Multimeter
Adapter-Connector Mi-Kro Grip P–5012.	
Tunable Bandpass Filter Telonic TTF–250–5–3EE.	Tunable filter 190 to 375 MHz.
Frequency Meter AN/USM–159.	Frequency meter

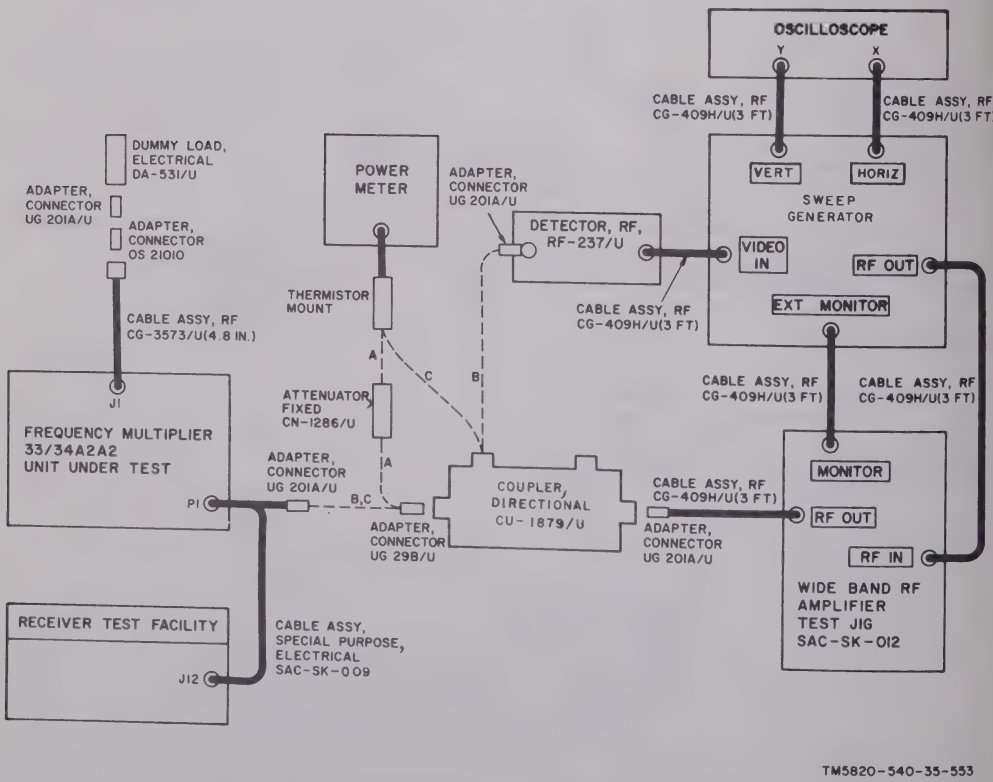

Figure 4–241. Frequency multiplier 33A2A2 or 34A2A2 input vswr check, test setup.

b. Test Procedures and Alignment.

(1) *Input vswr check.*

(*a*) Connect the test equipment as shown A, figure 4–241.

(*b*) Adjust the sweep generator controls to ovide a sweep between 97.5 and 145 MHz at an put level to the unit under test of +14 dbm +4 dbm indication on the power meter). Set the 0 and 10 MHz marker switches to on.

(*c*) Connect the test equipment as shown in , figure 4–241.

(*d*) Set the receiver test facility switches 1 to ON and S6 away from OFF.

(*e*) Adjust the oscilloscope controls for a onvenient display and note the frequency of the ighest level of reflected power using the sweep enerator markers.

(*f*) Set the sweep generator to cw at the frequency noted in (*e*) above.

(*g*) Connect the test equipment as shown in C, figure 4–241. Record the power meter indication. Reverse the input and output connections to the directional coupler. The power meter should indicate more than 11.3 db above the level recorded above.

(*h*) If requirement in (*g*) is not met proceed as follows:

1. Remove assembly cover on side opposite to P1. Remove the three retaining screws on low pass filter 33A2A2FL1 (fig. 4–243).

2. Extend the filter from the frequency multiplier using an adapter, connector UG–1879/U and an adapter-connector Mi-Kro Grip P–5012.

3. Reconnect the test equipment as shown in B, figure 4–241.

4. Slightly adjust C1 and C5 (fig. 4–243) to obtain the best compromise of minimum reflected power over the frequency range.

(2) *Output power checks.*

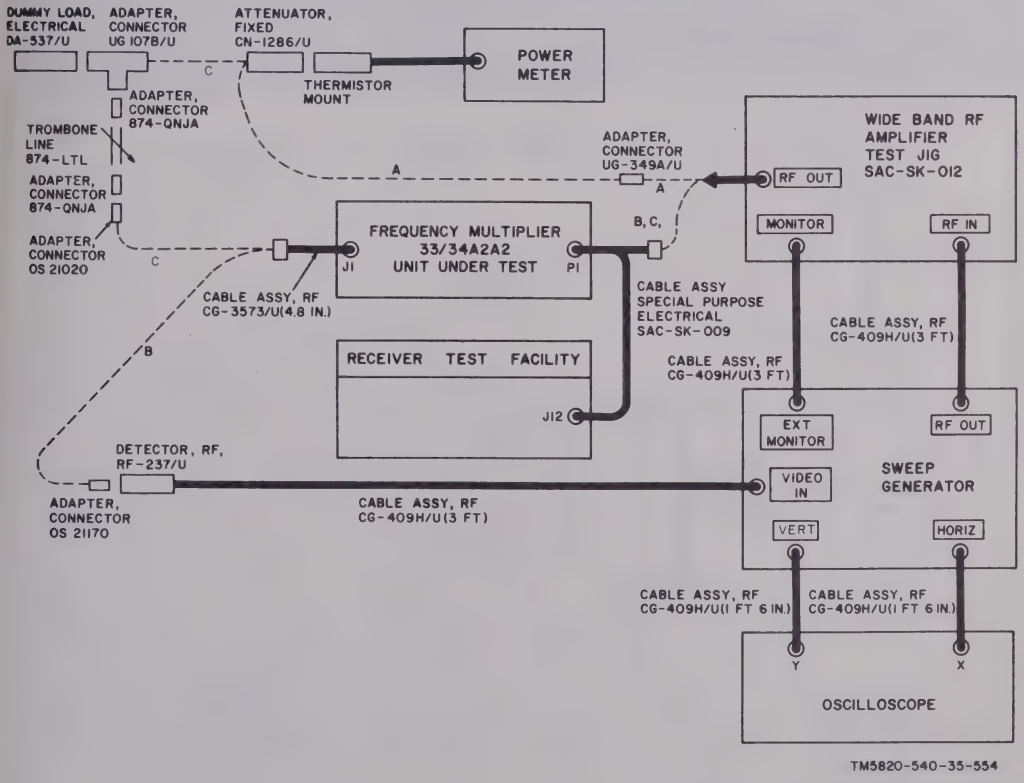

Figure 4–242. Frequency multiplier 33A2A2 or 34A2A2 power output check, test setup.

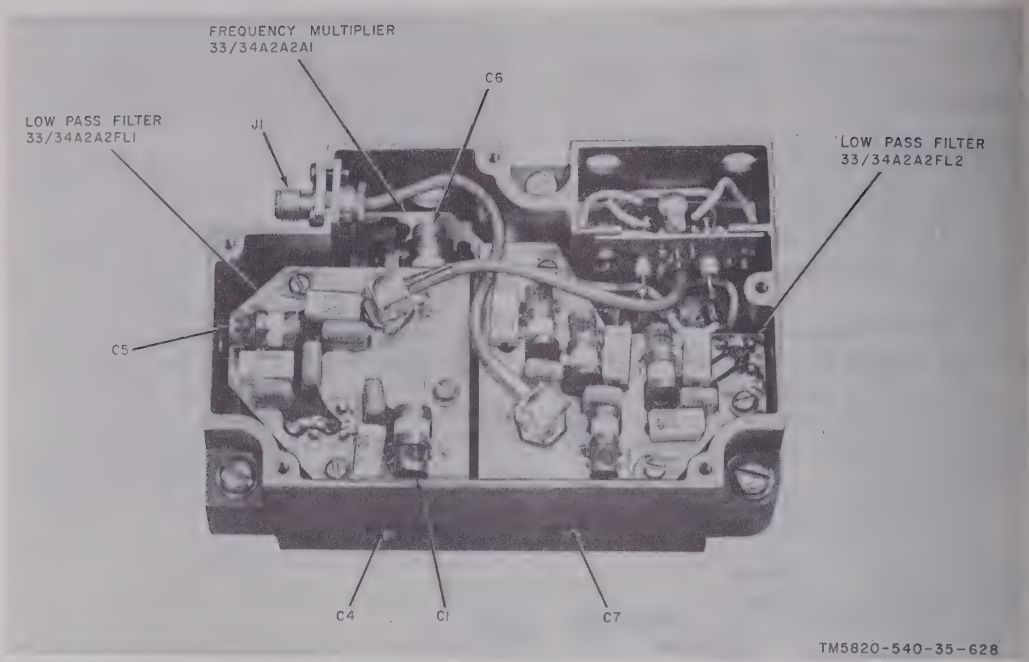

Figure 4-243. Frequency multiplier 33A2A2 or 34A2A2 top view, cover removed.

(*a*) Connect the test equipment as shown in A, figure 4–242.

(*b*) Set the sweep generator to CW and adjust the output level controls for +17 dbm (+7 dbm indication on the power meter) at the output of the test jig.

(*c*) Connect the test equipment as shown in B, figure 4–242.

(*d*) Set the receiver test facility switches S1 to ON and S6 away from OFF.

(*e*) Set the sweep generator controls to sweep between 97.5 and 145 MHz and adjust the oscilloscope controls for a convenient display.

(*f*) Adjust C4, C6 and C7 on the unit under test (fig. 4–243) for maximum response amplitude with reasonable flatness between 195 and 290 MHz. Note the frequency of minimum amplitude using the sweep generator markers.

(*g*) Set the sweep generator frequency to the minimum noted in (*f*) above and set the sweep width to minimum.

(*h*) Connect the test equipment as shown in C, figure 4–242.

(*i*) Adjust the trombone line for minimum output power as indicated on the power meter. The power output must be +14 dbm ±2.5 db (+1 dbm ±2.5 db as indicated on the power meter).

(*j*) Repeat step (*i*) above for sweep generator frequencies of 110, 120, 130 and 145 MHz.

(*k*) Connect the test equipment as shown in A, figure 4–242.

(*l*) Not used.

(*m*) Adjust the sweep generator output level controls for +13 dbm at the output of the test jig.

(*n*) Repeat steps (*h*) through (*j*) above.

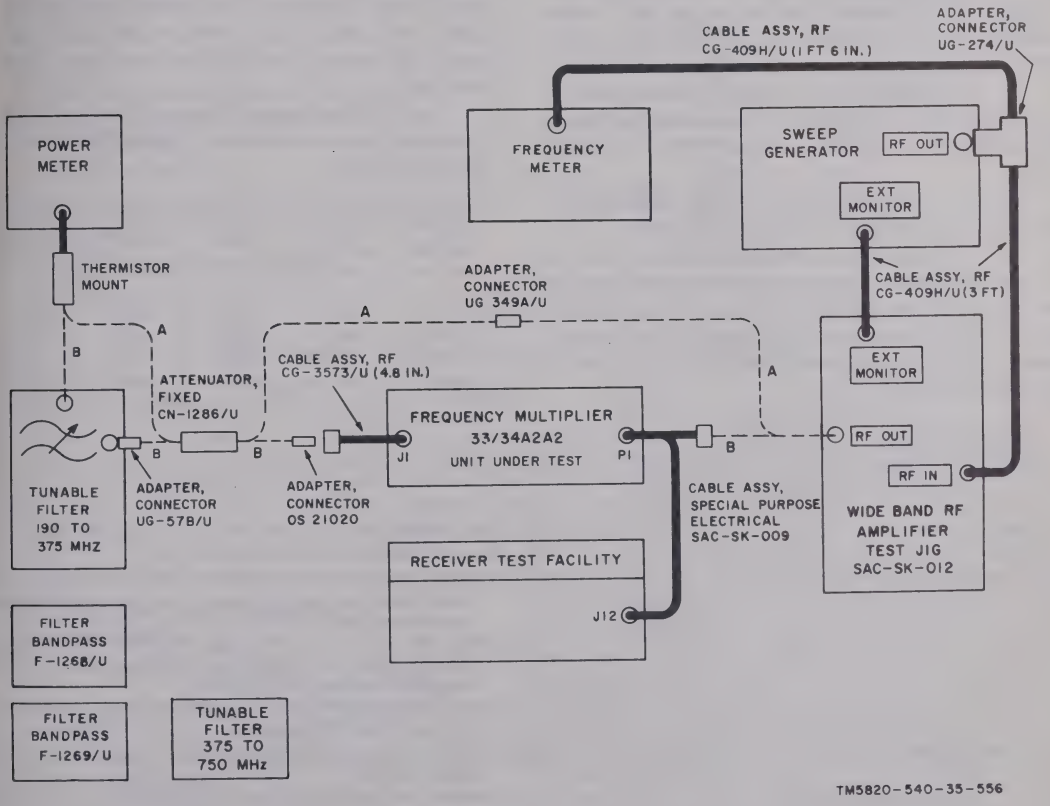

Figure 4–244. Frequency multiplier 33A2A2 or 34A2A2 harmonic rejection check, test setup.

(3) *Harmonic rejection check.*

(*a*) *Initial check.*

1. Connect the test equipment as shown in A, figure 4–244.

2. Set receiver test facility switches S1 to ON and S6 away from OFF.

3. Adjust the sweep generator frequency to 98 MHz cw (fo) as indicated on the frequency meter.

4. Adjust the sweep generator output level for +17 dbm from the wide band RF amplifier test jig (+7 dbm indication on the power meter).

5. Connect the test equipment as shown in B, figure 4–244.

6. Set the 190 to 375 MHz tunable filter to 196 MHz (fo × 2). Note the power meter indication.

7. Set the tunable filter to 294 MHz (fo × 3).

8. Adjust C1 on the unit under test (fig. 4–243) for minimum indication on the power meter. The power meter should indicate at least 20 db below the level noted in *6* above.

9. Repeat step *3* above for sweep generator frequency of 140 MHz. Set the tunable filter to 280 MHz (fo × 2). Note the power meter indication.

10. Replace the 190 to 375 MHz tunable filter with the 375 to 750 MHz tunable filter.

11. Set the tunable filter to 420 MHz (fo × 3). The power meter should indicate at least 20 db below the level noted in (2) (*g*) above. If necessary slightly readjust C1 to meet this requirement. If C1 is readjusted, repeat steps *3* and *5* through *8* above.

(*b*) *Harmonic rejection check.*

1. Connect the test equipment as shown in A, figure 4–244.

2. Adjust the sweep generator controls to provide a 97.5-MHz cw (fo) signal at an input level to the unit under test of +17 dbm (+7 dbm indication on the power meter). Connect the equipment as in B, figure 4–244.

3. Set the 190 to 375 MHz tunable filter to the unit under test output frequency fo × 2 (195 MHz). Note the power meter indication.

NOTE

In the following steps, insure that whenever a harmonic is being checked, a bandpass filter whose tuning range includes that harmonic is connected in the test setup (B, fig. 4–244).

4. Set the appropriate tunable filter to the harmonic outputs (fo, fo × 3 and fo × 4) listed in the table below for sweep generator frequency 97.5 MHz. The power meter should indicate 20 db below the level noted in *3* above, for all harmonics.

5. Repeat steps *1* through *4* above for the remaining sweep generator frequencies listed in the table below.

Sweep generator freq. (fo) MHz	Unit under test output freq. (fo × 2) MHz	Harmonic output frequencies (filter setting)		
		(fo) MHz	(fo × 3) MHz	(fo × 4) MHz
97.5	195.0	97.5	292.5	390.0
110.0	220.0	110.0	330.0	440.0
120.0	240.0	120.0	360.0	480.0
130.0	260.0	130.0	390.0	520.0
145.0	290.0	145.0	425.0	580.0

c. Troubleshooting (fig. 7–10).

Symptom	Checks and corrective measures
1. High vswr	Replace low pass filter 33/34A2A2FL1 (fig. 4–243) and test defective subassembly as shown in para 4–125.
2. Output power low or zero	*a.* Perform resistance and voltage measurements contained in *d* below. Investigate any abnormal indication. Replace components as required. *b.* Check the RF signal path using the allocated voltmeter. Refer to table in *d* below for typical indications. Check components and replace if required. *c.* Check for damaged cables or connectors and broken wires. Replace or repair if required.
3. Poor rejection	*a.* Remove low pass filter 33/34A2A2FL1 and test as shown in para 4–125. *b.* Remove low pass filter 33/34A2A2FL2 and test as shown in para 4–126. *c.* Check C1 on circuit card assembly 33/34A2A2A1 (fig. 4–245) and replace if required.

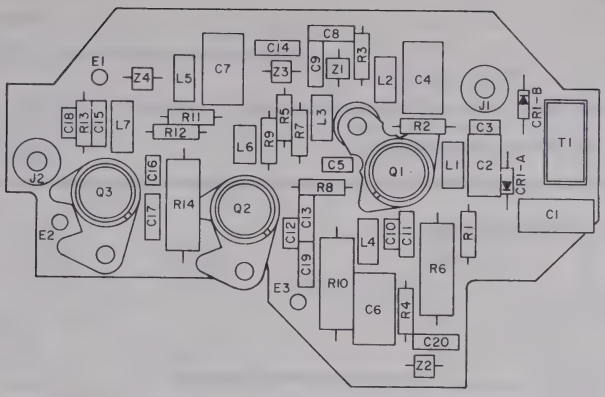

Figure 4-245. Circuit card assembly 33A2A2A1 or 34A2A2A1, parts location.

d. Voltage and Resistance Measurements (fig. 4-245).

NOTE

Use the allocated multimeter for dc voltage and resistance measurements. Use the allocated RF voltmeter for RF voltage measuresments.

(1) *Dc and RF voltage measurements referenced to ground.*

(2) *Resistance measurements.*

Test points	Typical indication	
	volts dc	volts rms
33/34A2A2A1Q1—emitter	+6.5	
—base	+6.6	0.5
—collector	+12.0	0.5
33/34A2A2A1Q2—emitter	+1.5	
—base	+2.25	0.2
—collector	+12.0	1.0
33/34A2A2A1Q3—emitter	+1.5	
—base	+2.4	0.12
—collector	+12.0	0.4

NOTE

All resistances measured with the allocated multimeter.

Stage	Transistor		Base (−)				Base (+)			
	Ref.	Type	Emitter (+)		Collector (+)		Emitter (−)		Collector (−)	
			Res (ohms)	Multimeter range	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range
	Q1		200k	X10,000	600	X100	650	X100	500	X100
	Q2		200k	X10,000	1k	X100	700	X100	650	X100
	Q3		550	X100	400	X100	550	X100	240	X100

4-125. Low Pass Filter 33A2A2FL1 or 34A2A2FL1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility Receiver TS-2867(V)1/GRM-95(V).	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V).	Accessory kit
Generator, Sweep SG-888	Sweep generator
Cable Assembly, Special Purpose, Electrical SAC-SK-009.	
Oscilloscope AN/USM-281	Oscilloscope
Indicator, Standing Wave Ratio AN/UPM-108.	Vswr indicator
Generator, Signal SG-409( )/U.	Signal generator No. 1

b. Test Procedures and Alignment.

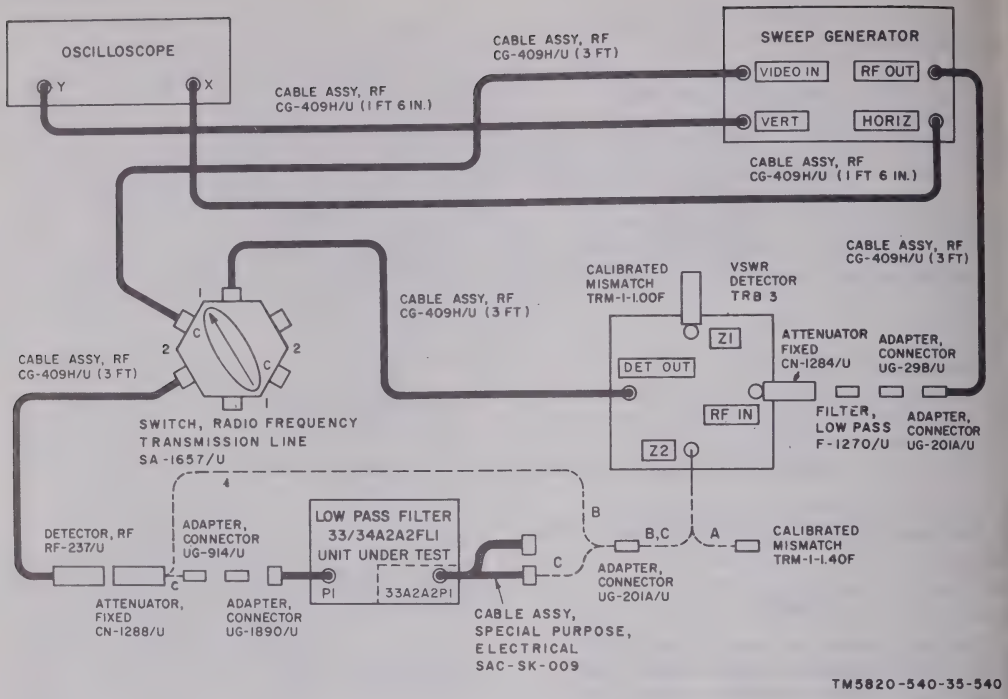

Figure 4–246. Low-pass filter 33A2A2FL1 or 34A2A2FL1 vswr and bandpass insertion loss check, test setup.

(1) *Vswr check.*

(*a*) Connect the test equipment as shown in A, figure 4–246.

(*b*) Adjust the sweep generator controls to provide a sweep between 97.5 and 145 MHz.

(*c*) Set coaxial switch to position 1.

(*d*) Adjust the oscilloscope controls and the sweep generator attenuator dial for a convenient oscilloscope display. Mark the display on the graticule of the oscilloscope. This represents a vswr of 1.4:1.

(*e*) Connect the test equipment as shown in C, figure 4–246.

(*f*) The vswr curve displayed on the oscilloscope must not exceed the 1.4:1 calibration mark on the oscilloscope graticule.

(*g*) If the vswr is excessive, adjust C1 and C5 on the unit under test (fig. 4–247) for minimum deflection on the oscilloscope.

(2) *Bandpass insertion loss check.*

(*a*) Connect the test equipment as shown in B, figure 4–246.

(*b*) Adjust the sweep generator controls to provide a sweep between 97.5 and 145 MHz. Set the sweep generator attenuator dial to 1 db.

(*c*) Set the coaxial switch to position 2.

(*d*) Adjust the oscilloscope controls for a convenient indication of the response and mark the oscilloscope at the point of minimum deflection across the bandwidth. This is the 1 db reference level.

(*e*) Turn the sweep generator attenuator dial to 0 db, and mark the oscilloscope at the point of minimum deflection. This is the 0 db reference level.

(*f*) Interpolate between the 0 db and 1 db reference levels and mark the 0.75 db reference level on the graticule.

(*g*) Connect the test equipment as shown in C, figure 4–246.

(*h*) The insertion loss over the pass band must not exceed the 0.75 db level as recorded in step (*f*) above.

(3) *Out-of-band rejection check.*

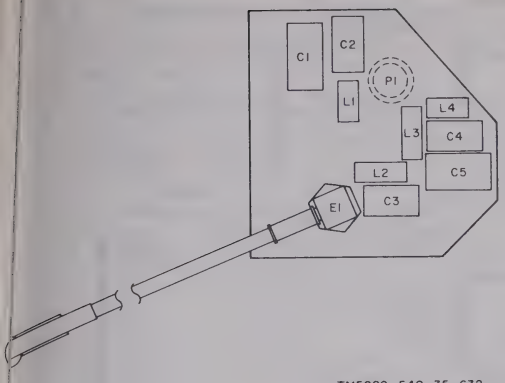

Figure 4–247. Low-pass filter 33A2A2FL1 or 34A2A2FL1, parts location.

(*a*) Connect the test equipment as shown in A, figure 4–248.

(*b*) Adjust signal generator No. 1 controls to provide a 190-MHz signal modulated with 1000 Hz at a level of 30 percent and set the output attenuator dial to 0 dbm.

(*c*) Set the variable attenuator dials to 0 db.

(*d*) Adjust the vswr indicator controls for a convenient indication. Note this indication.

(*e*) Connect the test equipment as shown in B, figure 4–248.

(*f*) Adjust the variable attenuators to obtain the same indication on the vswr indicator as noted in step (*d*) above. The attenuation required must be 30 db or greater.

4–126. Low-Pass Filter 33A2A2FL2 or 34A2A2FL2

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	
Oscilloscope AN/USM–281	Oscilloscope
Generator, Sweep SG–888	Sweep generator
Indicator, Standing Wave Ratio AN/UPM–108.	Vswr indicator
Adapter-Connector Omni Spectra 21190.	Adapter-connector OS21190
Adapter-Connector Omni Spectra 21170.	Adapter-connector OS21170
Generator, Signal SG–409( )/U.	Signal generator No. 1

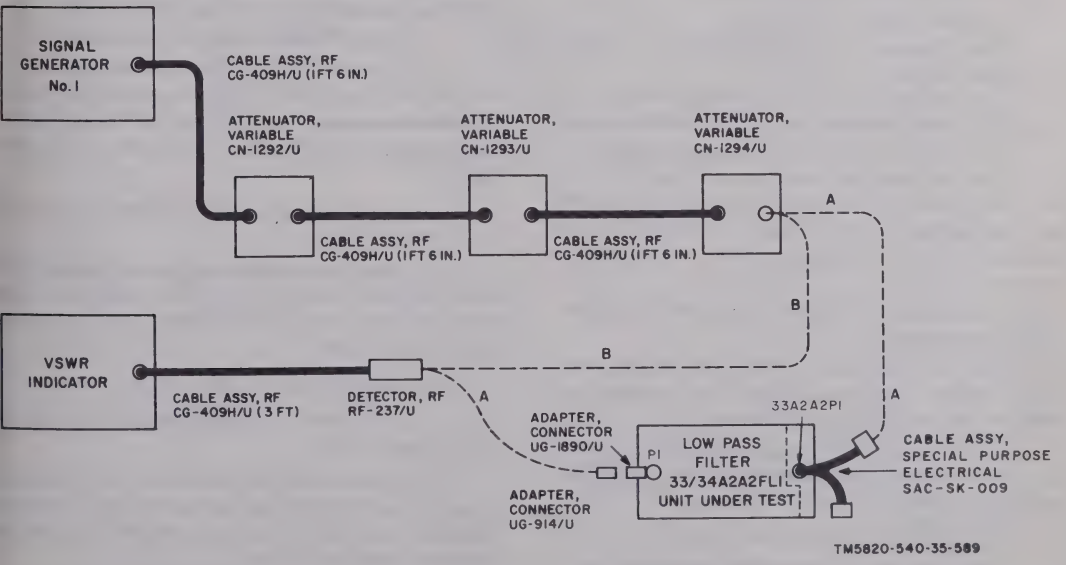

Figure 4–248. Low-pass filter 33A2A2FL1 or 34A2A2FL1 out-of-band rejection check, test setup.

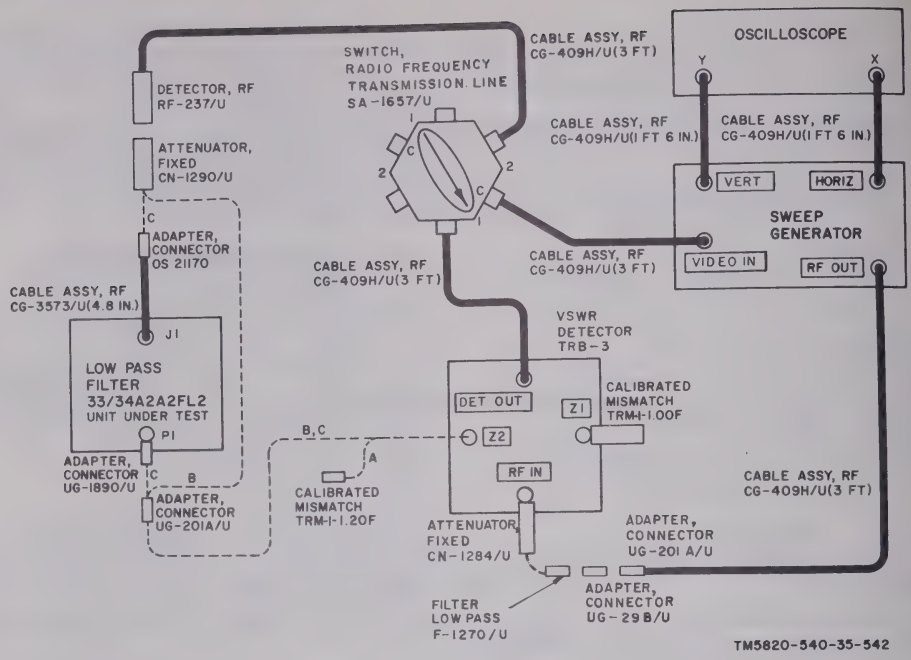

Figure 4-249. Low-pass filter 33A2A2FL2 or 34A2A2FL2 vswr and bandpass insertion loss check, test setup.

b. Test Procedures and Alignment.

(1) *Vswr check*

(*a*) Connect the test equipment as shown in A, figure 4-249.

(*b*) Adjust the sweep generator controls to provide a sweep between 190 and 300 MHz.

(*c*) Set the coaxial switch to position 1.

(*d*) Adjust the oscilloscope controls and the sweep generator attenuator dial for a convenient oscilloscope display. Mark the display on the graticule of the oscilloscope. This represents a vswr of 1.20:1.

(*e*) Connect the test equipment as shown in C, figure 4-249.

(*f*) The vswr curve displayed on the oscilloscope must not exceed the 1.2:1 calibration mark on the oscilloscope graticule.

(*g*) If the vswr is excessive, adjust C2, C4, C6 and C8 on the unit under test (fig. 4-250) for minimum deflection on the oscilloscope.

(2) *Bandpass insertion loss check.*

(*a*) Connect the equipment as shown in B, figure 4-249.

(*b*) Adjust the sweep generator controls to provide a sweep between 190 and 300 MHz. Set the sweep generator attenuator dial to 1 db.

(*c*) Set the coaxial switch to position 2.

(*d*) Adjust the oscilloscope controls for a convenient indication of the response and mark the oscilloscope at the point of minimum deflection across the bandwidth. This is the 1 db reference level.

(*e*) Connect the test equipment as shown in C, figure 4-249.

(*f*) Set the sweep generator attenuator dial to 0 db. The insertion loss over the pass band must not exceed the 1 db reference level recorded in step (*d*) above.

(3) *Out-of-band rejection check.*

(*a*) Connect the test equipment as shown in A, figure 4-251.

(*b*) Adjust signal generator No. 1 controls to provide a 380-MHz signal modulated with 1000 Hz at a level of 30 percent and set the output attenuator dial to 0 dbm.

(*c*) Set the variable attenuator dials to 0 db.

(*d*) Adjust the vswr indicator controls for a convenient indication. Note this indication.

(*e*) Connect the test equipment as shown in B, figure 4–251.

(*f*) Adjust the variable attenuators to obtain the same indication on the vswr indicator as noted in step (*d*) above. The attenuation required must be 13 db or greater.

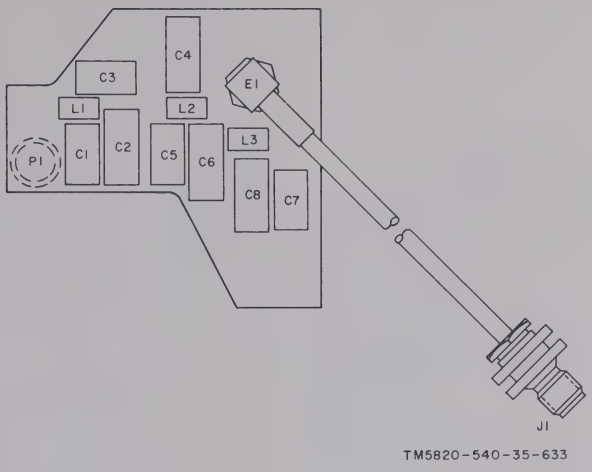

Figure 4–250. Low-pass filter 33A2A2FL2 or 34A2A2FL2, parts location.

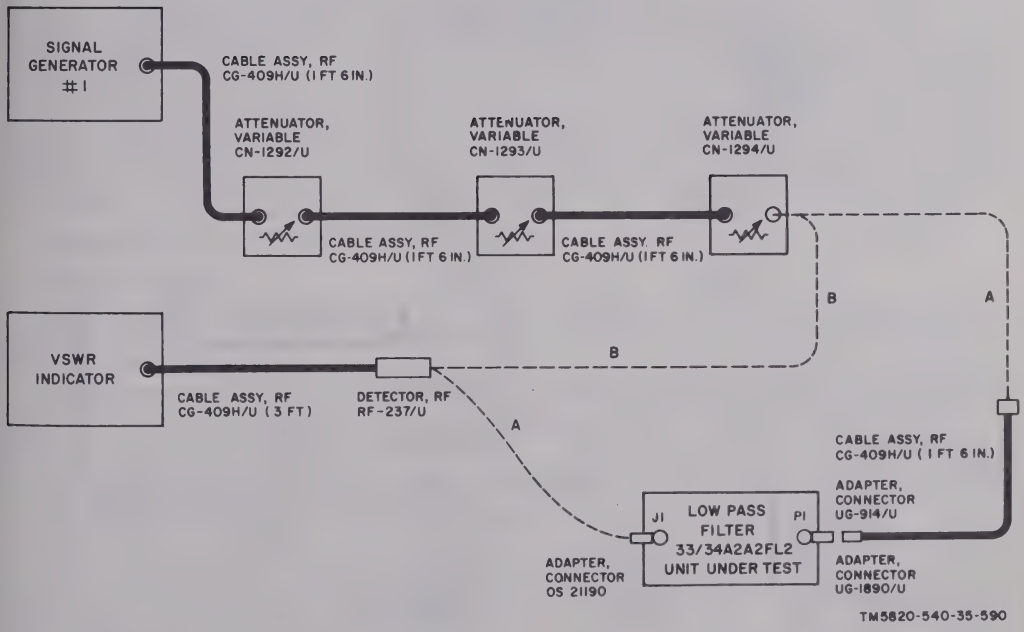

Figure 4–251. Low-pass filter 33A2A2FL2 or 34A2A2FL2 out-of-band rejection check test setup.

4–127. Bandpass Filter 33A2FL1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Accessory Kit, Test Facilities Set, MK–1173(V)1/GRM–95(V).	Accessory kit
Oscilloscope AN/USM–281	Oscilloscope
Generator, Sweep SG–888	Sweep generator
Generator, Signal SG–340A/G.	Signal generator No. 2
Frequency Meter AN/USM–159.	Frequency meter
Dummy Load Telonic TRM–1–1.60F.	Calibrated mismatch TRM–1–1.60F.
Adapter-Connector Omni Spectra OS21190.	Adapter-connector OS21190
Adapter-Connector Omni Spectra OS21030 (2 required).	Adapter-connector OS21030
Indicator, Standing Wave Ratio AN/UPM–108.	Vswr indicator
Band Pass Filter Tuning Law Test Jig SM–E–696049.	Test jig

b. Test Procedures.

(1) *Bandwidth and tuning law check.*

(*a*) Install the bandpass filter on the test jig and clamp it securely into position. Attach and tighten the drive extension of the test jig to the drive shaft of the filter.

(*b*) Connect the test equipment as shown in D, figure 4–252.

(*c*) Remove the filter cover plate. Slacken the test jig knurled locking screw and rotate the center knob until the tuning capacitors C1 and C5 (fig. 4–253) are in the fully unmeshed position.

(*d*) Set coaxial switch to position 2.

(*e*) Adjust the sweep generator controls to provide a sweep of approximately 15 MHz centered on 737 MHz and set the output attenuators to 0 db. Switch on the 50, 10 and 1 MHz markers.

(*f*) Adjust the oscilloscope controls for a convenient indication.

(*g*) Rotate the test jig center knob counterclockwise until the oscilloscope response peaks at 737 MHz. Replce the filter cover plate.

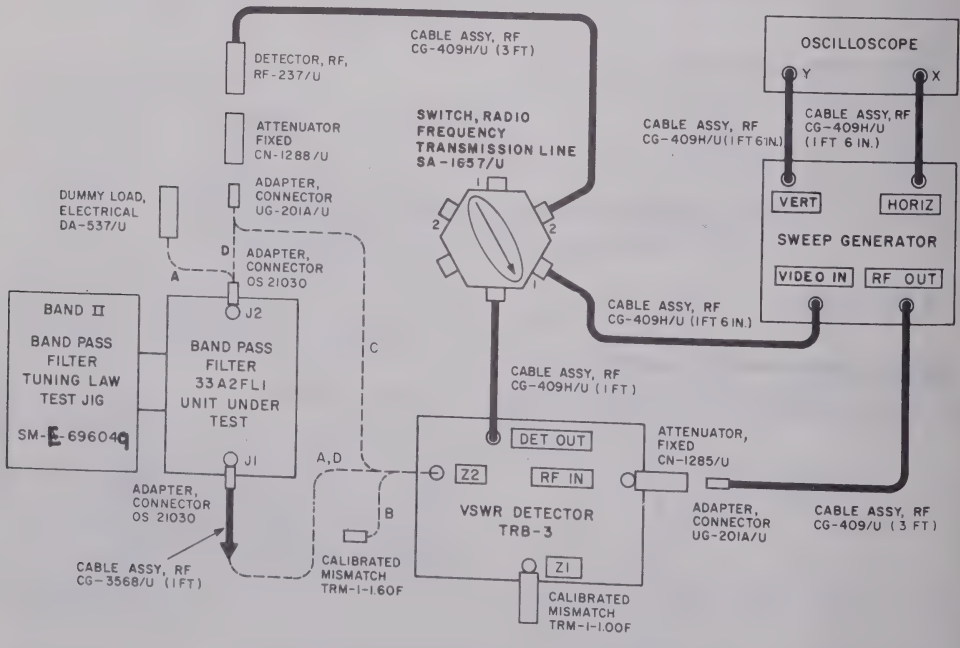

Figure 4–252. Bandpass filter 33A2FL1 bandwidth, tuning law, vswr and insertion loss checks, test setup.

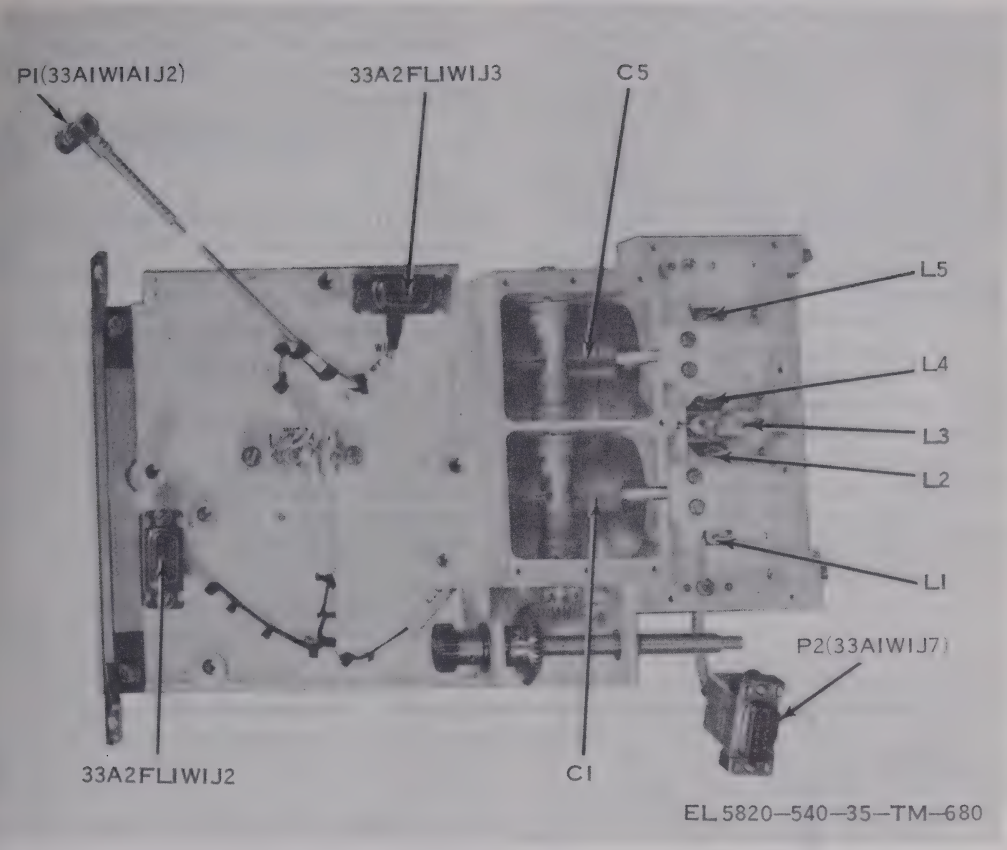

Figure 4-253. Bandpass filter 33A2FL1 top view, cover removed.

(*h*) Position the test jig index to dial number 737 and tighten the locking thumbscrew using the capstan bar provided.

(*i*) Decrease the output of the sweep generator by 3 db and mark a horizontal line on the oscilloscope graticule at the response curve peak. This is the 3 db bandwidth reference level.

(*j*) Increase the sweep generator output level by 3 db.

(*k*) Set the test jig index to 735. Center the response on the oscilloscope by adjusting the sweep generator center frequency. The bandpass response center frequency must be between 733.5 and 736.5 MHz.

(*l*) Not used.

(*m*) The 3 db bandwidth, calculated using the sweep generator markers, must be between 6 and 10 MHz.

(*n*) Repeat (*i*) through (*m*) above for the following frequencies and test jig settings.

Test jig index positions	Response center frequency	
	Min MHz	Max MHz
735.0	733.5	736.5
695.2	693.5	696.5
662.0	660.5	663.5
631.7	630.5	633.5
605.7	604.0	607.0
582.0	580.5	583.5
561.0	559.5	562.5
541.8	540.5	543.5
523.9	522.5	525.5
508.0	506.5	509.5
492.6	491.0	494.0

Test jig index positions	Response center frequency	
	Min MHz	Max MHz
480.0	478.5	481.5
467.3	466.0	469.0
457.0	455.5	458.5
445.6	444.0	447.0
434.5	433.0	436.0
425.0	423.5	426.5

(*o*) If filter misalignment is suspected refer to *d* below for complete alignment procedures.

(2) *Input vswr and insertion loss check.*

(*a*) Connect the test equipment as shown in B, figure 4–252.

(*b*) Set the coaxial switch to position 1.

(*c*) Adjust the sweep generator controls to provide a sweep between 425 and 735 MHz and set the output attenuators to 0 db. Switch on the 50, 10 and 1 MHz markers.

(*d*) Adjust the oscilloscope controls for a convenient display.

(*e*) Calibrate the oscilloscope for a vswr of 1.6:1 from 425 to 735 MHz.

(*f*) Connect the test equipment as shown i A, figure 4–252.

(*g*) Rotate the test jig dial over the fre quency range and note that the response peal extends below the 1.6:1 vswr calibration mark o the oscilloscope.

(*h*) Connect the test equipment as show in C, figure 4–252 and set the coaxial switch t position 2.

(*i*) Add 2 db of attenuation to the sweep generator output and mark the oscilloscope graticule at the peak of the response. This is the —2 db reference level.

(*j*) Remove the 2 db of attenuation.

(*k*) Connect the test equipment as shown in D, figure 4–252.

(*l*) Not used.

(*m*) Tune the unit under test through the frequency range, observing that the peak of the response equals or exceeds the —2 db reference level, indicating an insertion loss of 2 db or less.

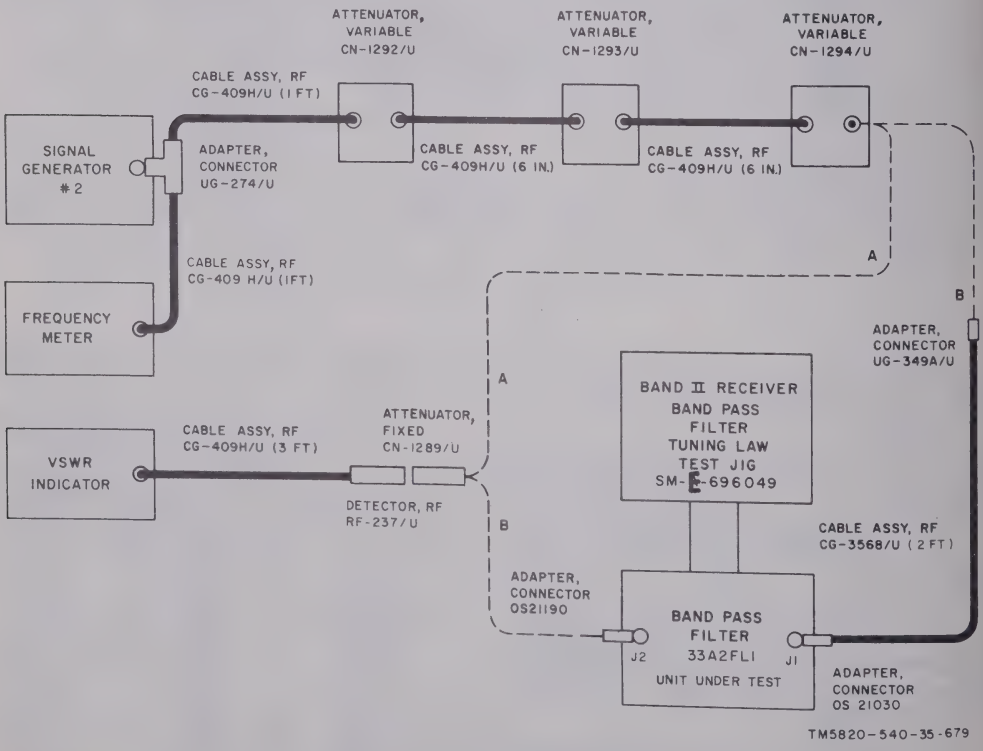

Figure 4–254. Bandpass filter 33A2FL1 rejection check, test setup.

(3) *Rejection check.*

(*a*) Connect the test equipment as shown in A, figure 4–254.

(*b*) Set the variable attenuator dials to provide 35 db of attenuation.

(*c*) Set signal generator No. 2 controls to provide maximum output at a frequency of 425 MHz. Modulate this signal with 1000 Hz at a level of 30 percent.

(*d*) Adjust the vswr indicator for a convenient indication and record this reference level.

(*e*) Connect the test equipment as shown in B, figure 4–254.

(*f*) Rotate the test jig dial to index 424.

(*g*) Adjust signal generator No. 2 controls to provide maximum output at a frequency of 50 MHz above that of the test jig as indicated on the frequency meter. Modulate this signal with 1000 Hz at a level of 30 percent.

(*h*) Adjust the variable attenuator dials to 0 db.

(*i*) The indication on the vswr indicator must be less than that recorded in step (*d*) above.

(*j*) Repeat steps (*g*) and (*i*) above for a signal generator frequency 50 MHz below that of the test jig.

(*k*) Repeat steps (*f*) through (*j*) above for the following test jig indexes: 478, 559, 631 and 737 MHz.

c. Troubleshooting (fig. 7–6).

Symptom	Checks and corrective measures
1. High vswr and/or insertion loss	*a.* Check all components in RF path. *b.* Ground contacts on variable capacitors C1 and C5 should be clean and maintain good tension. *c.* Deterioration of coil form and/or adjustable tuning cores. Replace if required. *d.* Alignment may be required as described in *d* below.
2. Bandwidth or tuning law not as specified	Align as described in *d* below.

d. Alignment Procedures.

(1) *Initial adjustments.*

(*a*) Install the bandpass filter on the test jig and clamp securely in position. Attach and tighten the drive extension of the test jig to the drive shaft of the filter.

(*b*) Remove the filter cover plate and visually check that the ganged capacitors C1 and C5 (fig. 4–253) are in alignment with each other and ensure that the blades are parallel.

(*c*) Set test probe assembly switches S1 and S2 to OUT. Connect and secure probe assembly to the cavity of the unit under test.

(*d*) Connect the test equipment as shown in A, figure 4–255. Set test probe assembly switch S2 to IN.

(*e*) Set the sweep generator output attenuators to 0 db and adjust the frequency and level controls for maximum leveled output over the frequency range of 425 to 735 MHz.

(*f*) Connect the test equipment as shown in B, figure 4–255.

(*g*) Set the sweep generator center frequency to 425 MHz. Slacken the test jig knurled locking screw and rotate the center knob to adjust C1 and C5 for a peak response at 425 MHz as viewed on the oscilloscope.

(*h*) Add 3 db of attenuation to the sweep generator output attenuator. Mark the nominal —3 db reference level on the graticule of the oscilloscope.

(*i*) Remove the 3 db of attentuation and set the sweep generator controls for a sweep width of approximately 15 MHz centered on 425 MHz.

(*j*) Adjust L5 (fig. 4–253) to obtain a 3 db bandwidth of at least 4.3 MHz using the sweep generator markers.

(*k*) Set the sweep generator center frequency to 735 MHz and rotate the test jig center knob to adjust C1 and C5 for a peak response at 735 MHz. The 3-db bandwidth must be 4.3 MHz or greater.

(*l*) Not used.

(*m*) If necessary, readjust L5 (fig. 4–253) and repeat steps (*g*), (*j*), and (*k*) above.

(*n*) Connect the test equipment as shown in C, figure 4–255; set test probe assembly switches S1 to IN and S2 to OUT.

(*o*) Repeat steps (*g*) and (*j*) through (*m*) above adjusting L1 to meet the requirements.

NOTE

The optimum condition is a 3-db band-

width of 4.3 MHz at all frequencies for each cavity resulting in a 6.1-MHz overall filter bandwidth. The compromise is that both cavities have the same bandwidth at the same frequency.

(2) *Final adjustments.*

(*a*) Connect the test equipment as shown in D, figure 4–255 with the test probe assembly removed.

(*b*) Set the sweep generator center frequency to 735 MHz and rotate the test jig center knob to adjust C1 and C5 for a peak response at 737 MHz.

(*c*) Bend the first arc of the capacitor rotor blades which are meshed with the stator blades to achieve the best tracking result.

(*d*) Adjust L2, L3 and L4 (fig. 4–253) to flatten the response and acquire a 3-db bandwidth of 6 to 10 MHz.

(*e*) On the test jig, position the index to 737 and securely lock the center knob such that the indexed dial moves with the drive shaft of the unit under test.

(*f*) Set the sweep generator center frequency to 696 MHz, position the test jig to index 696 and check the response.

(*g*) Set the sweep generator center frequency to 662 MHz, position the test jig to index 662 and bend the second arc of the capacitor blades for the best response.

(*h*) Repeat step (*g*) above for the frequencies and index positions listed below and bend the capacitor arc indicated for the best response.

Sweep generator center frequency	Holding fixture index	Capacitor arc adjustment
737	737	1st
662	662	2d
604	604	3d
559	559	4th
522	522	5th
491	491	6th
466	466	7th
444	444	8th
424	424	9th

(*i*) At index 424, establish that the 3-db bandwidth is between 6 and 10 MHz.

(*j*) If necessary readjust L2, L3 and L4 to meet the 3 db bandwidth requirement of 6 to 10 MHz. If L2, L3 and L4 are readjusted, recheck the 3 db bandwidth at 737 MHz.

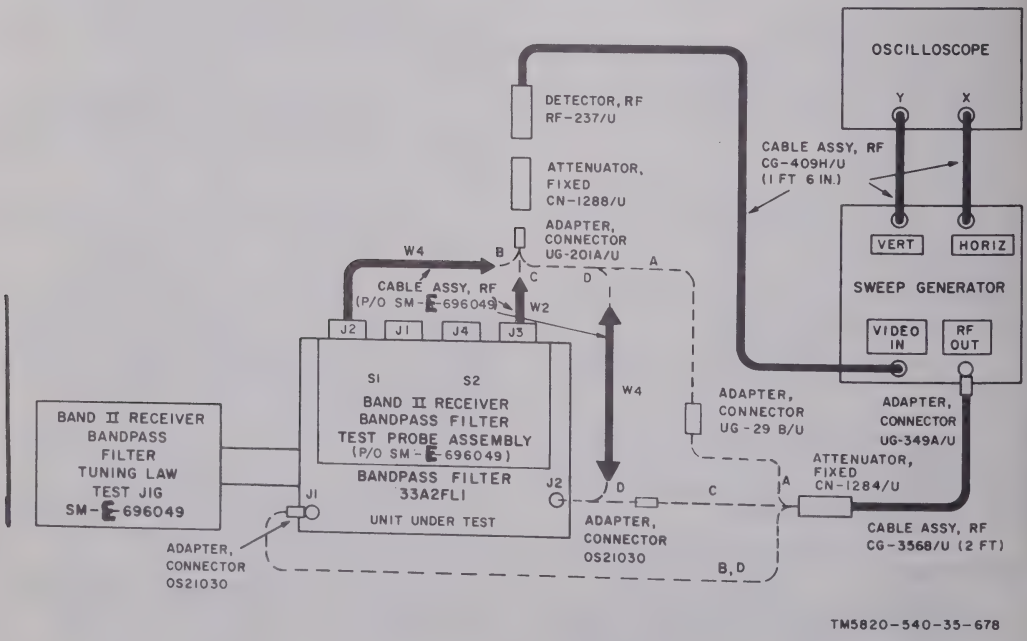

Figure 4–255. Bandpass filter 33A2FL1 alignment procedure, test setup.

–128. RF Power Monitor 33A3 or 34A3

a. Test Equipment and Material Required.

Equipment	Common name
est Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
ccessory Kit, Test Facilities Set, MK–1173(V)1/GRM–95(V).	Accessory kit
Drive Generator, Airborne Instruments Labs, Type 125.	Power signal source
Wattmeter AN/URM–120	Wattmeter
Generator, Signal SG–340A/G.	Signal generator No. 2
ndicator, Standing Wave Ratio AN/UPM–108.	Vswr indicator
Adapter-Connector Omni Spectra 21190 (2 required).	Adapter-connector OS21190
Adapter-Connector Omni Spectra 21030 (2 required).	Adapter-connector OS21030
Cable Assembly, Special Purpose, Electrical SAC–SK–015.	

b. Test Procedures.

(1) *Insertion loss check.*

(*a*) Connect the test equipment as shown in A, figure 4–256.

(*b*) Adjust the signal generator controls to provide a frequency of 1000 MHz modulated with 1 kHz at a level of 30 percent. Adjust the output attenuator dial to 0 dbm.

(*c*) Set the variable 1 db attenuator to 0.5 db.

(*d*) Adjust the vswr indicator controls for a convenient midscale indication. Record this indication.

(*e*) Connect the test equipment as shown in B, figure 4–256.

(*f*) Set the variable 1 db attenuator to 0.3 db. The indication on the vswr indicator must be the same as, or less than, that recorded in step (*d*) above. This represents an insertion loss of 0.2 db or less.

(2) *Power in vs voltage out check.*

(*a*) Connect the test equipment as shown in figure 4–257.

(*b*) Set receiver test facility switches S1 to ON, S5 to S6 and S6 to XMTR PWR.

(*c*) Adjust the power signal source controls to provide a frequency of 1000 MHz at an output level of 15 watts as read on the wattmeter. The meter indication on M1 of the test facility must be between 40 and 60 percent of full scale (within the green band).

(*d*) Switch off the power signal source.

(*e*) Reverse the wattmeter and power signal source connections on the unit under test.

(*f*) Set receiver test facility switch S6 to REFL PWR.

(*g*) Switch on the power signal source.

(*h*) Repeat steps (*c*) and (*d*) above.

4–129. Control-Indicator 33A4 or 34A4

Control-indicator 33/34A4 is physically and electrically identical to control-indicator 37A2. Refer to paragraph 4–111 for testing, troubleshooting, and alignment procedures. Use the channel num-

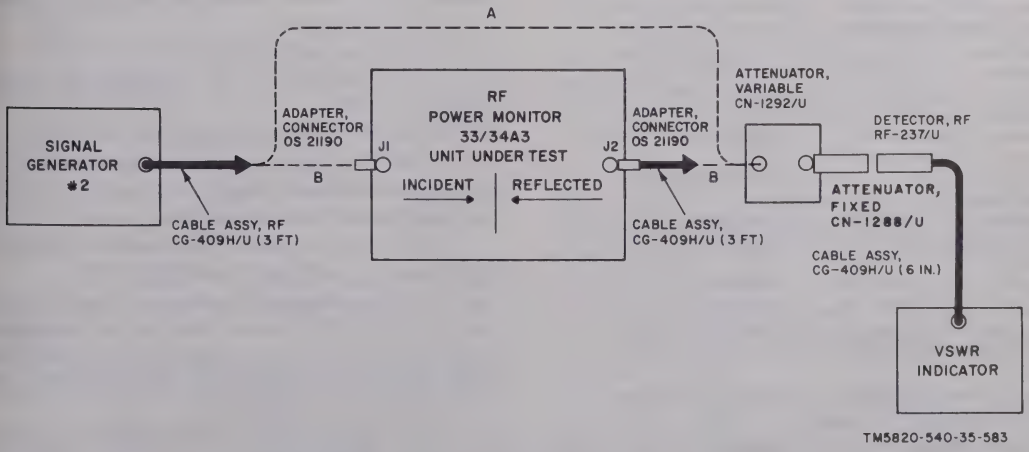

Figure 4–256. RF power monitor 33A3 or 34A3 insertion loss check, test setup.

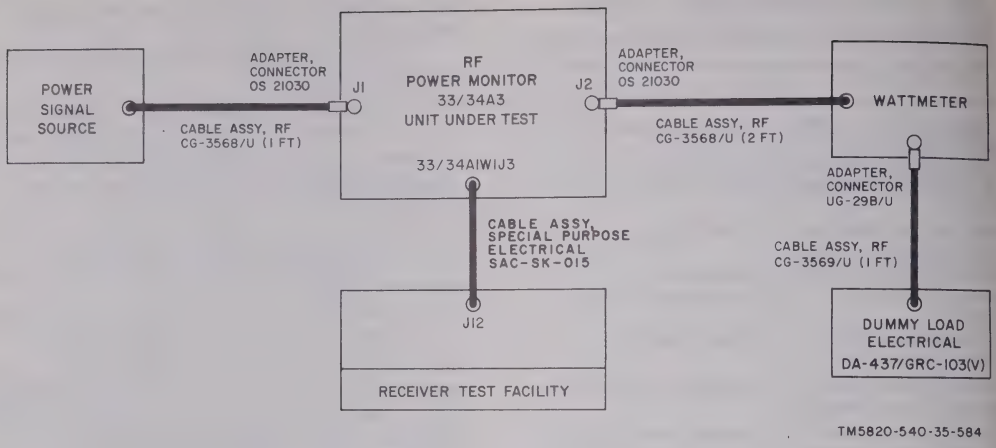

Figure 4–257. RF power monitor 33A3 or 34A3 power in vs voltage out check, test setup.

bers listed in the (33/34A4) channel No. column of the lamp display coding chart.

4–130. Signal Level Control-Monitor 33A5 or 34A5

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Receiver TS-2867(V)1/GRM-95(V).	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V).	Accessory kit
Voltmeter Vector Hewlett-Packard 8405A.	Vector voltmeter
Accessory Kit, Vector Voltmeter Hewlett-Packard 11570A.	50 ohms loads and 50 ohm T's
Generator, Sweep SG-888	Sweep generator
Generator, Signal SG-340A/G.	Signal generator No. 2
Indicator, Standing Wave Ratio AN/UPM-108.	Vswr indicator
Voltmeter, Digital AN/GSM-64.	Digital voltmeter
Wattmeter AN/URM-98	Power meter
Voltmeter, Electronic ME-247/U.	RF voltmeter
Oscilloscope, AN/USM-281	Oscilloscope
Wattmeter, AN/URM-120	Wattmeter
Drive Generator, Airborne Instruments Labs, Type 125.	Power signal source
Filter, Low Pass Telonic TLC-1000-5EF.	Filter TLC-1000-5EF
Circulator MELAB HD-1-450.	Circulator
Attenuator, Fixed Weinschel 693-30.	20-db 30-w attenuator
Adapter-Connector Omni Spectra 21010.	Adapter-connector OS21010
Adapter-connector Omni Spectra 21170.	Adapter-connector OS21170
Adapter-connector Omni Spectra 21190 (2 required).	Adapter-connector OS21190
Adapter-connector Omni Spectra 21020.	Adapter-connector OS21020
Cable Assembly, Special Purpose, Electrical SAC-SK-003.	
Frequency Meter AN/USM-159.	Frequency meter

b. Test Procedures.

(1) *Alarm level setting.*

(*a*) Connect the test equipment as shown in figure 4–258.

(*b*) Set the coaxial switch to position 1.

(*c*) Set the sweep generator controls to deliver a 600-MHz cw output at a level of +6 dbm as indicated on the power meter.

(*d*) Set the receiver test facility switch S1 to ON and turn switch S6 to REFL PWR.

(*e*) Set the coaxial switch to position 2. If the HIGH SIGNAL alarm lamp on the test facility is off, proceed to next step. If the alarm lamp is on, adjust R3 clockwise on the unit under test until the alarm lamp goes off.

(*f*) Adjust R3 on unit under test until alarm lamp just comes on.

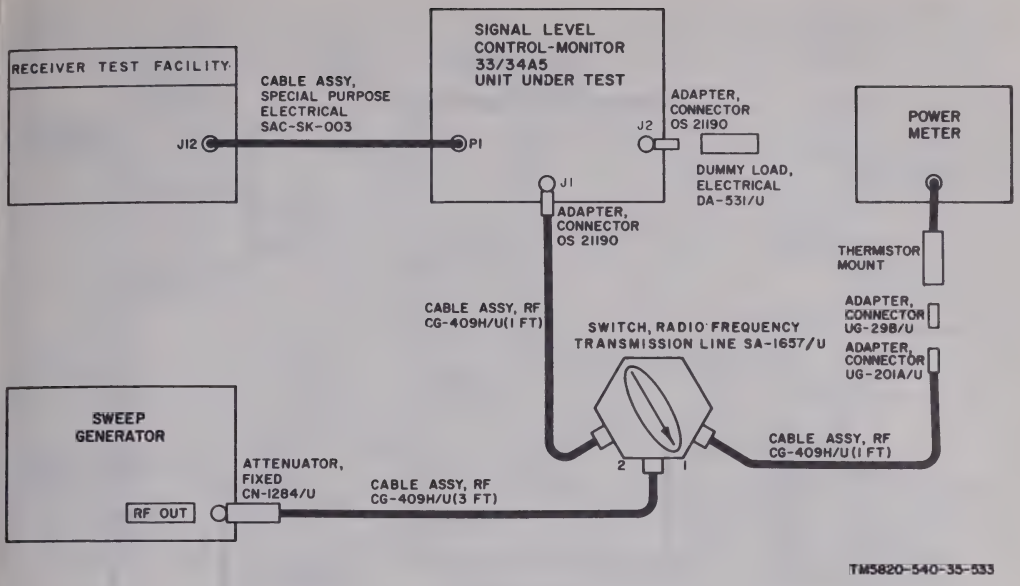

Figure 4–258. Signal level control-monitor 33A5 or 34A5 alarm level setting, test setup.

(*g*) Decrease the sweep generator output level by 16 db (to —10 dbm). Alarm lamp should go out.

(*h*) Increase the signal generator output by 20 db (to +10 dbm). Alarm lamp should come on.

(*i*) If the requirements of (*g*) and (*h*) above are not met, readjust R3 in the unit under test and repeat (*g*) and (*h*).

(2) *Input vswr check.*

(*a*) Connect the test equipment as shown in A, figure 4–259.

(*b*) Set the receiver test facility switch S1 to ON and turn switch S6 to REFL PWR.

(*c*) Set the sweep generator controls to deliver a sweep output at a level of —10 dbm as indicated on the power meter.

(*d*) Connect the 1.25:1 calibrated mismatch to the Z1 port of the vswr detector (B, fig. 4–259).

(*e*) Calibrate the oscilloscope for a vswr of 1.25:1 over the frequency range 395 to 1000 MHz.

(*f*) Connect the test equipment as shown in C, figure 4–259. The vswr of the unit under test should not exceed 1.25:1 over the frequency range 395 to 1000 MHz. If the vswr exceeds 1.25:1 continue below.

(*g*) Determine and note the frequency at which vswr is highest.

(*h*) Connect the test equipment as shown in figure 4–260.

(*i*) Set the sweep generator controls to deliver a cw output at the frequency noted in (*g*) above.

(*j*) Set the sweep generator output level for —30 dbm as indicated on the vector voltmeter, channel A.

(*k*) Switch the vector voltmeter to channel B and note the indication.

(*l*) Not used.

(*m*) The difference between the vector voltmeter channel A and channel B indications should not be less than 17.5 db, corresponding to a vswr of 1.3:1 or better.

(3) *Insertion loss check.*

(*a*) Connect the test equipment as shown in A, figure 4–261.

(*b*) Set signal generator No. 2 controls to deliver 1000 MHz at —10 dbm as indicated on the signal generator attenuator dial, modulated with 1 kHz at 30 percent level.

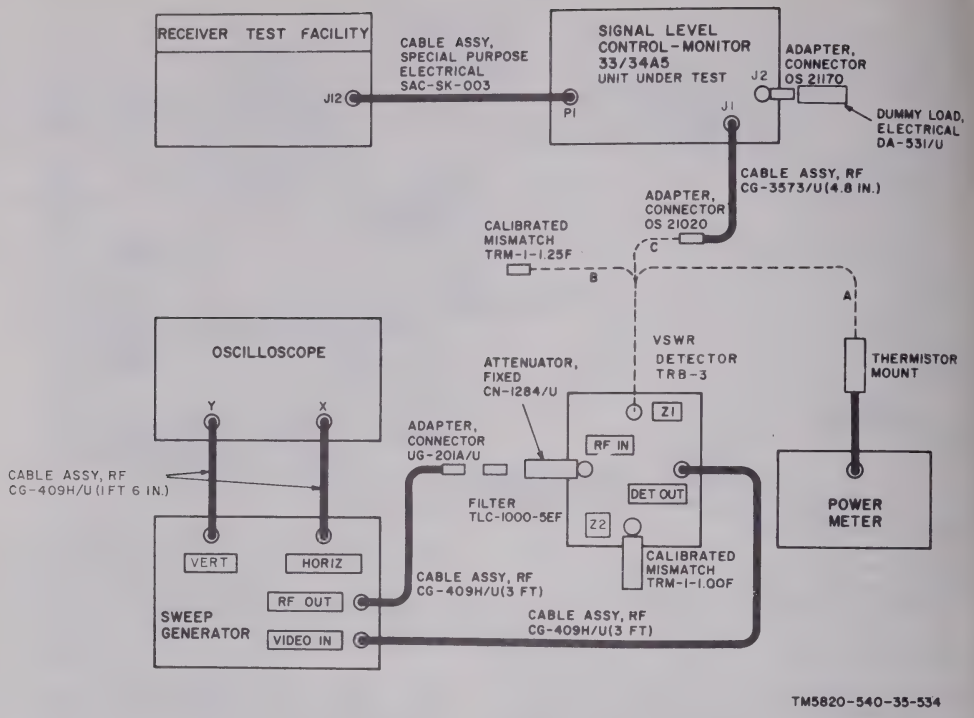

Figure 4–259. Signal level control-monitor 33A5 or 34A5 initial input vswr check, test setup.

NOTE

Insertion loss increases sharply above 1000 MHz.

(*c*) Set the variable attenuator to 1.0.

(*d*) Adjust the vswr amplifier for a convenient indication. Note the indication.

(*e*) Connect the equipment as shown in B, figure 4–261.

(*f*) Adjust the variable attenuator to obtain the same indication as that noted in (*d*) above. The difference between this variable attenuator setting and 1.0 is the insertion loss and should not exceed 0.75 db.

(4) *Isolation check.*

(*a*) Connect the test equipment as shown in figure 4–262.

(*b*) Set the test facility switches S1 to ON and S6 to REFL PWR.

(*c*) Set the power signal source to 450 MHz and adjust the level for an indication of 35 watts on the wattmeter. The power level at the output of the unit under test should not exceed 50 milliwatts (+17 dbm) (power meter indication of —13 dbm maximum).

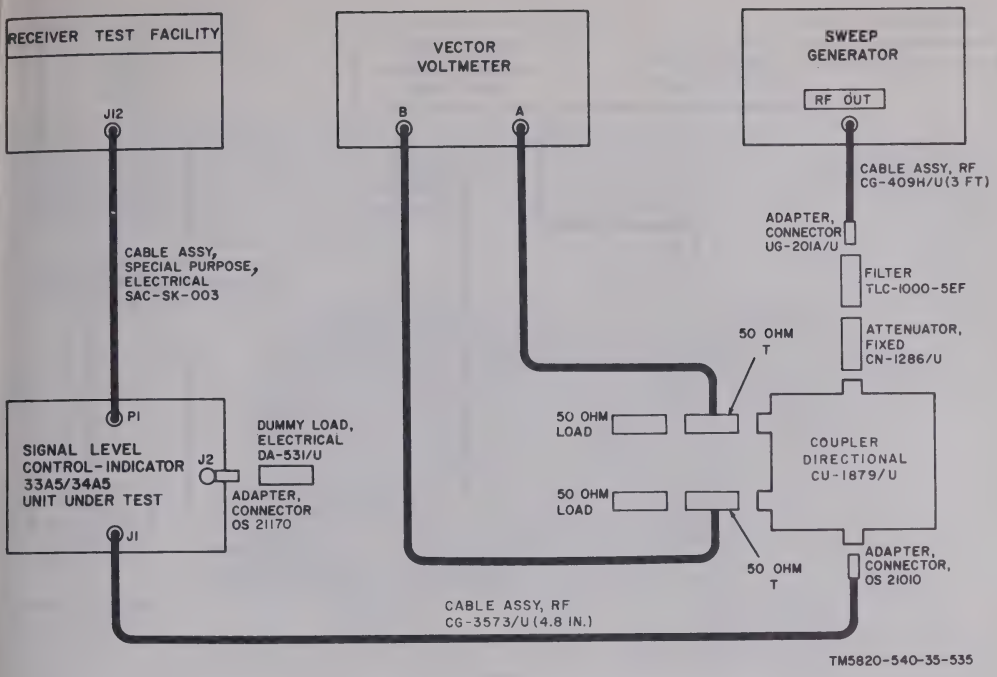

Figure 4-260. Signal level control-monitor 33A5 or 34A5 final input vswr check, test setup.

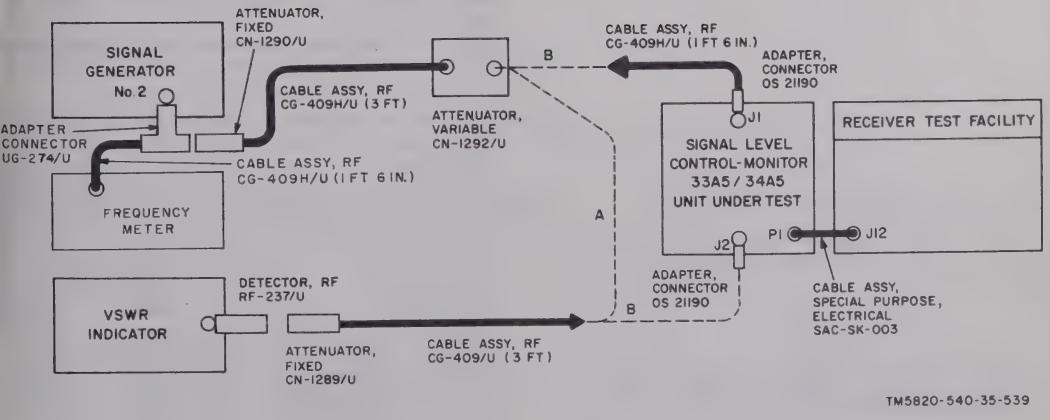

Figure 4-261. Signal level control-monitor 33A5 or 34A5 insertion loss check, test setup.

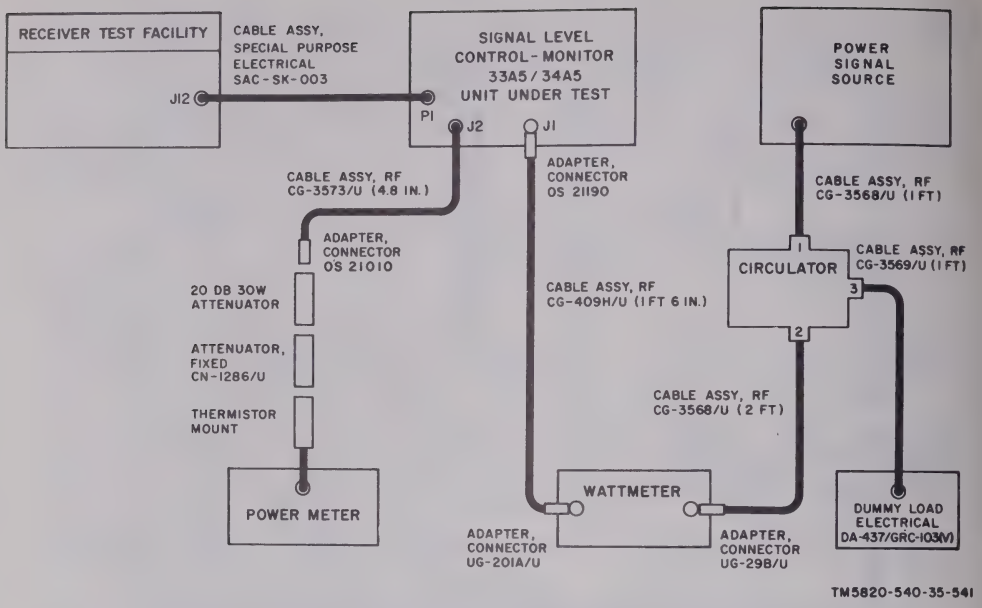

Figure 4–262. Signal level control-monitor 33A5 or 34A5 isolation check, test setup.

c. Troubleshooting. (fig. 7–8).

Symptom	Checks and corrective measures
1. High signal alarm lamp does not light	*a.* Check the rf signal level at the junction of 33/34A5CR1 (fig. 4–263) and A1 of 33/34A5A1 (fig. 4–264) using the allocated rf voltmeter to ascertain that signal is present to "switch on" the alarm control subassembly. This level should be 0.4 volts rms. Check components and replace if required. *b.* Check the voltage on transistors (fig. 4–265) as established in *d* below. Investigate any abnormal indication. Replace defective components. *c.* If Q1 dc base voltage requirement is not met check for defective pin 33/34A5CR1 (fig. 4–263) and/or RF limiter A1 of 33/34A5A1 (fig. 4–264).
2. High vswr	Check the wiring and components in the RF path from J1 to J2. Replace defective components. RF limiter 33A5A1A1 is probable cause.
3. High insertion loss and/or poor isolation	Check the wiring and components in the RF path from J1 to J2. Replace defective components. CR1, CR2, CR3 or A1 suspected.

d. Voltage and Resistance Measurements (fig. 4–264).

NOTE

Use the allocated digital voltmeter for voltage measurements.

(1) *Dc voltage measurements referenced to ground* (+10 dbm input level to unit under test).

Test Points	Typical indication (volts dc)	
	Alarm on	Alarm off
33/34A5A2Q1—base	−0.3	−0.1
—emitter	+0.25	+0.2
—collector	−0.08	+12.0
33/34A5A2Q3—base	−0.1	−12.0
—emitter	−0.66	−12.0
—collector	−0.6	+25.9
33/34A5A2Q3—base	−0.57	+25.9
—collector	+0.08	+0.01

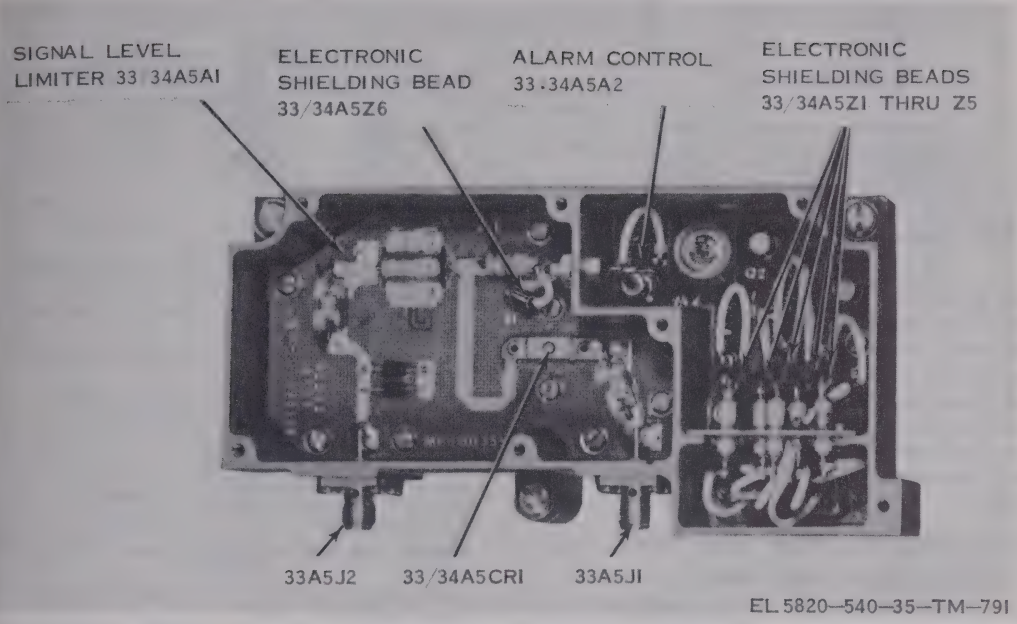

Figure 4-263. Signal level control-monitor 33A5 or 34A5 top view, cover removed.

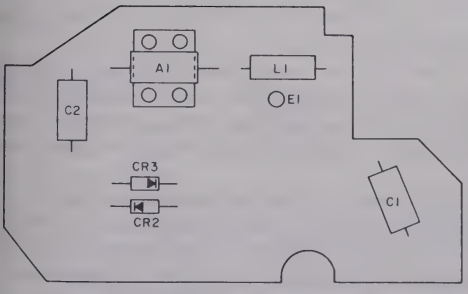

Figure 4-264. Signal level limiter 33A5A1 or 34A5A1, parts location.

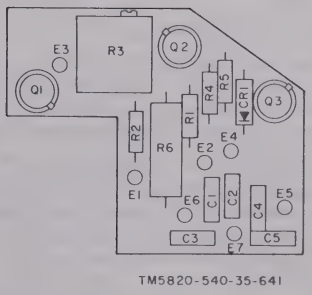

Figure 4-265. Alarm control 33A5A2 or 34A5A2, parts location.

(2) *Resistance measurements.*

NOTE

All resistances measured with the allocated multimeter.

Transistor		Base (−)				Base (+)			
		Emitter (+)		Collector (+)		Emitter (−)		Collector (−)	
Ref.	Type	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range
Q1	2N2907	1k	X100	1k	X100	600k	X10,000	Infinity	X10,000
Q2	2N2222A	120k	X10,000	Infinity	X10,000	840k	X100	810	X100
Q3	2N2907	1k	X100	1k	X100	100k	X10,000	Infinity	X10,000

4–131. Radio Signal Distribution Panel 33A6 or 34A6

This is the front panel of the receiver RF head RF power from the transmitter passes through the panel at the FROM XMTR connector into the transmit portion of the duplexer. Transmitted power to the antenna and receiver power from the antenna passes through the panel at the ANT connector. Control-indicator 33A4 or 34A4 is mounted on the panel. No testing is required.

4–132. Frequency Mixer Stage 33A7

a. Test Equipment and Material Required.

Equipment	*Common name*
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Test Facility, Receiver TS–2867(V)1/GRM–95(V)1	Receiver test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Oscilloscope AN/USM–281	Oscilloscope
Generator, Sweep SG–888	Sweep Generator
Generator, Signal SG–409( )/U.	Signal generator No. 1
Generator, Signal SG–340A/G.	Signal generator No. 2
Indicator, Standing Wave Ratio AN/UPM–108	SWR Meter
Voltmeter, Vector Hewlett-Packard 8405A.	Vector voltmeter
Accessory Kit, Vector Voltmeter Hewlett-Packard 11570A.	50-ohm loads and 50-ohm 'T's
Frequency Meter AN/USM–159.	Frequency meter
Generator, Thermal Noise SG–427/U and Power Supply.	High frequency noise generator.
Unit IF Amplifier, General Radio Model 1216–A.	Unit IF amplifier
Multimeter TS–352B/U	Multimeter
Voltmeter, Digital AN/GSM–64.	Digital voltmeter (DVM)
Vswr Bridge ANZAC RB–3	Vswr bridge RB–3
Wattmeter AN/URM–98	Power meter
Frequency Mixer Stage Test Jig SM–E–696028.	Mixer test jig
Amplifier, GP LA–2300–43	Low noise IF amplifier LA–2300–43
Wideband RF Amplifier SM–C–696030.	Wideband RF amplifier
30-MHz Gaussian Filter SM–A–698149	
Filter, Low Pass Telonic TLC–1000–5EF.	Filter TLC–1000–5EF
Filter, Low Pass Telonic TLC–705–8EF.	Filter TLC–705–8EF
Filter, Low Pass Telonic TLC–290–5EF.	Filter TLC–290–5EF
Detector, RF XD–23A	Detector XD–23A
Adapter-Connector 874–QBJL (3 required).	
Adapter-Connector 874–QBJA	
Adapter-Connector 874–QBPA	
Adapter-Connector 874–QNJL (2 required).	
Adapter-Connector Omni Spectra 21190	Adapter-connector OS21190
Adapter-Connector Omni Spectra 21900	Adapter-connector OS21900
Adapter-Connector Omni Spectra 21030	Adapter-connector OS21030

b. Test Procedures.

NOTE

It is recommended that the following tests be performed in an RFI free environment.

(1) *RF input VSWR and local oscillator level metering checks.*

(*a*) Connect the test equipment as shown in figure 4–266A.

(*b*) On the signal generator No. 1 adjust the frequency to 395 MHz, MOD SELECTOR to 1000 Hz, MOD LEVEL to 100%, and the output level for a −14 dbm indication on the power meter.

(*c*) Connect the test equipment as shown in figure 4–266B. Set SWR meter to HIGH (CRYSTAL IMPEDANCE) and adjust RANGE and GAIN control for a suitable reference reading. This will be the 2.0:1 VSWR reference.

(*d*) Connect the test equipment as shown in figure 4–266C. The reading on the SWR meter should be less than the reference obtained in (*c*) above (i.e., VSWR better than 2.0:1).

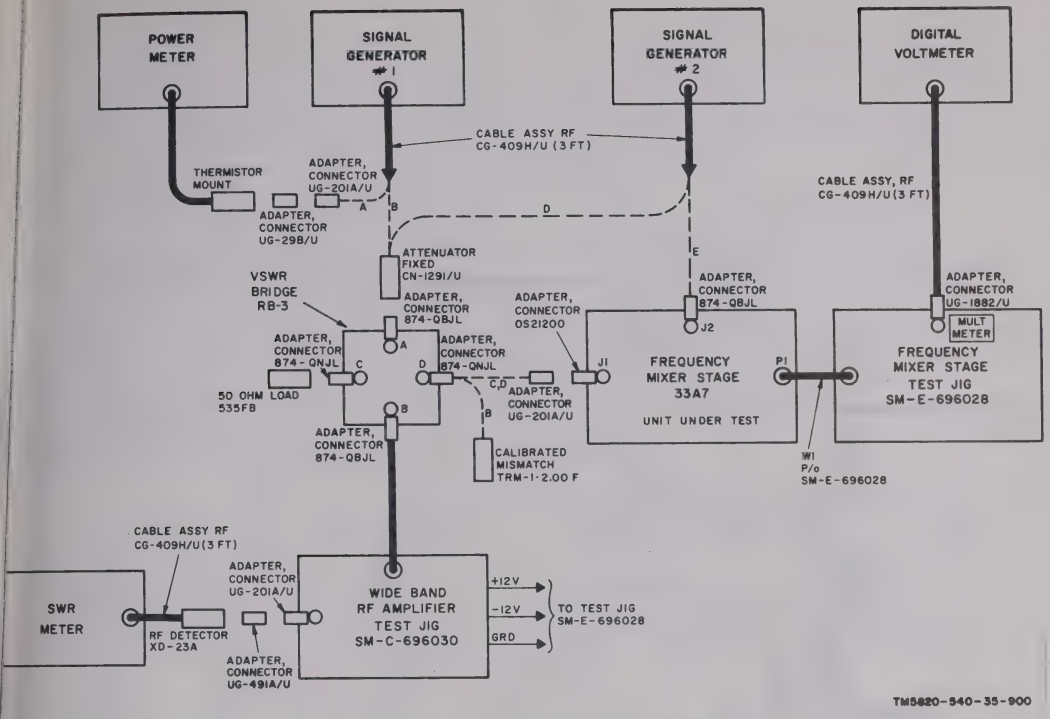

Figure 4–266. Frequency mixer stage, RF input vswr and local oscillator level metering.

(*e*) Connect equipment as shown in figure 4–266D and repeat steps (*b*), (*c*) and (*d*) above, at frequencies of 550 and 705 MHz.

(*f*) Connect the test equipment as shown in figure 4–266E. On signal generator No. 2 adjust the frequency to 500 MHz (CW) and the output level to 6 dbm. The digital voltmeter indication should be greater than 135 mv.

(2) *Conversion gain and image rejection checks.*

(*a*) Connect the equipment as shown in figure 4–267A.

(*b*) Set the sweep generator to 395 MHz (CW) as indicated on the frequency mixer and adjust the output for a −10 dbm indication on the power meter.

(*c*) Disconnect the frequency meter from the VSWR bridge and connect it to the output of signal generator No. 1. Set signal generator No. 1 at a frequency 30 MHz higher than the sweep generator frequency in (*b*) above (425 MHz). Reconnect the frequency meter to the VSWR bridge.

(*d*) Connect the power meter as shown in figure 4–267B. Adjust signal generator No. 1 output level for a +7 dbm indication on the power meter.

(*e*) Connect the test equipment as shown in figure 4–267C.

(*f*) Note the vector voltmeter indication. Subtract this indication from −40 dbm (RF input at J1 of unit under test). The result is the conversion gain which should be 14 ± 4 db.

(*g*) Connect the test equipment as shown in figure 4–267A. Set the sweep generator at a frequency 60 MHz higher than in (b) above (455 MHz) and adjust the output level for a −10 dbm indication on the power meter.

(*h*) Note the vector voltmeter indication. Substract this indication from the indication obtained in (*f*) above to obtain the image rejection; this should be a minimum of 15 db.

(*i*) Substitute signal generator No. 2 for signal generator No. 1 and repeat steps (*b*) to (*h*) above, starting with a sweep generator frequency of 550 MHz.

(*j*) Substitute filter TLC–1000–5EF in place of filter TLC–705–8EF and repeat steps (*b*) to (*h*) above, starting with a sweep generator frequency of 705 MHz.

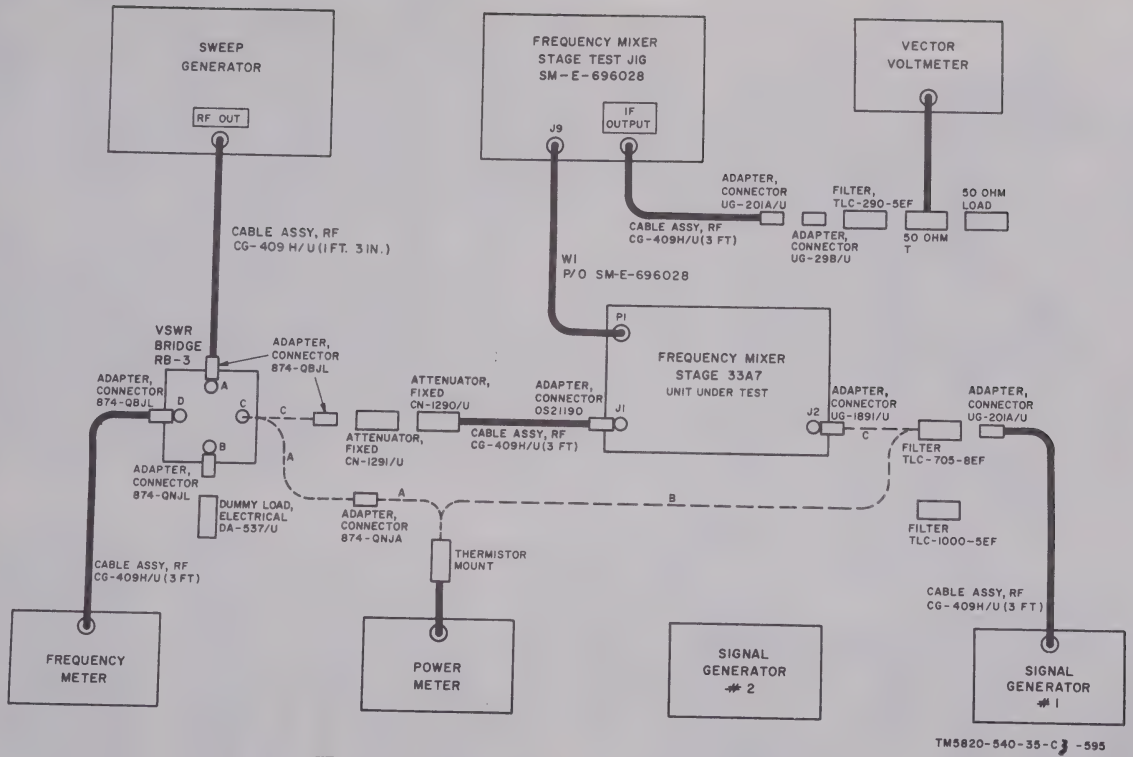

Figure 4-267. Frequency mixer stage 33A7 conversion gain and image rejection check, test setup.

(3) *Noise figure check.*

(*a*) Connect the test equipment as shown i figure 4–268A.

(*b*) Set signal generator No. 1 to 425 MHz indicated on the frequency meter. Set the riable attenuator to 0.

(*c*) Connect the test equipment as shown i figure 4–268B.

(*d*) Set the variable attenuator to 0 and djust the signal generator No. 1 output level r a +6 dbm indication on the power meter.

(*e*) Connect the equipment as shown in fi- ure 4–268C.

(*f*) Note the indication on the unit IF mplifier.

(*g*) Fire the noise generator and set the ischarge current to 200 ma. Adjust the vari- ble attenuator to obtain the same indication on the unit IF amplifier as noted in (*f*) above.

(*h*) The attenuation added in (*g*) above is the Y-factor. Using this Y factor calculate the noise figure using figure 4–269. From this noise figure subtract 6 db (attenuator at J1). The result is the true noise figure and should not exceed 4.5 db.

NOTE

Attenuation versus frequency data on the 6 db calibrated attenuator should be used in the Y factor calculation.

(*i*) Substitute signal generator No. 2 and filter TLC–1000–5EF for signal generator No. 1 and TLC–705–8EF respectively.

(*j*) Adjust frequency of signal generator No. 2 to 735 MHz and repeat steps (*b*) through (*h*) above.

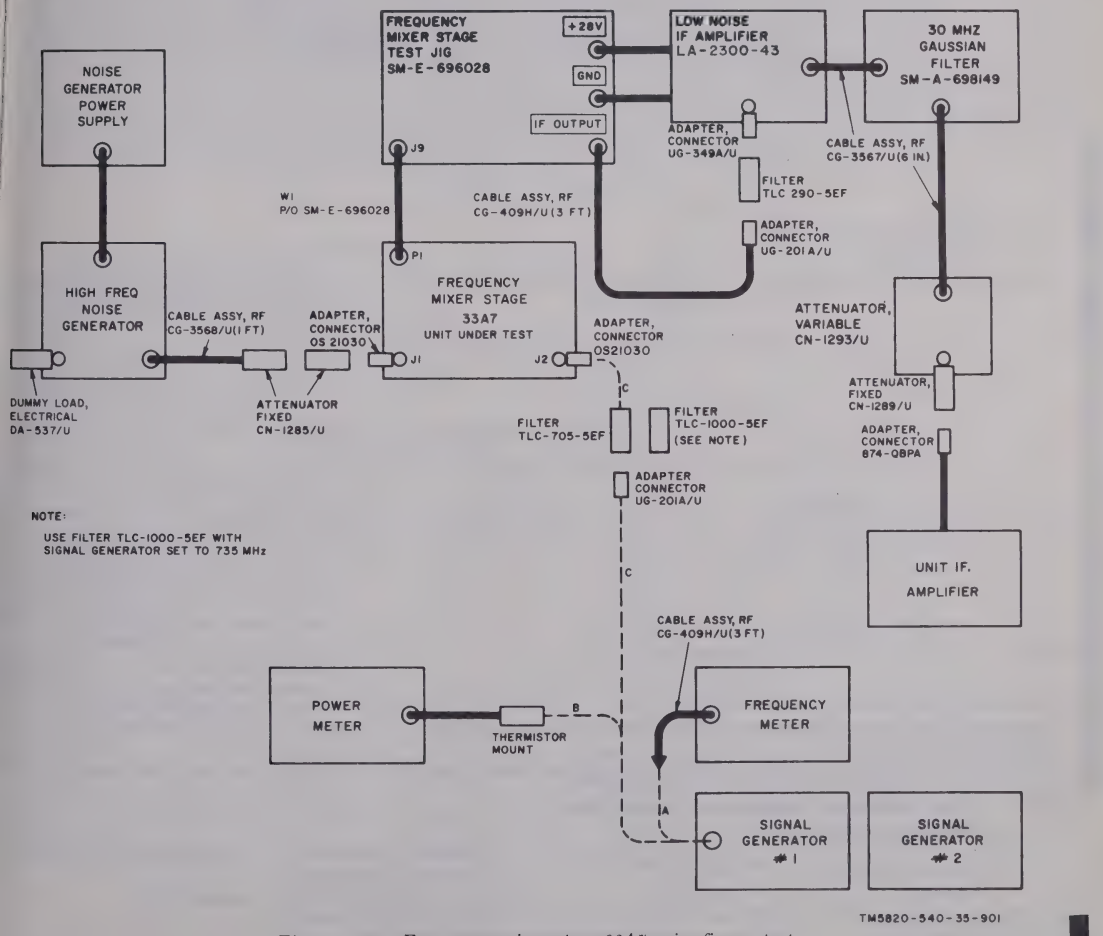

Figure 4–268. Frequency mixer stage 33A7 noise figure, test setup.

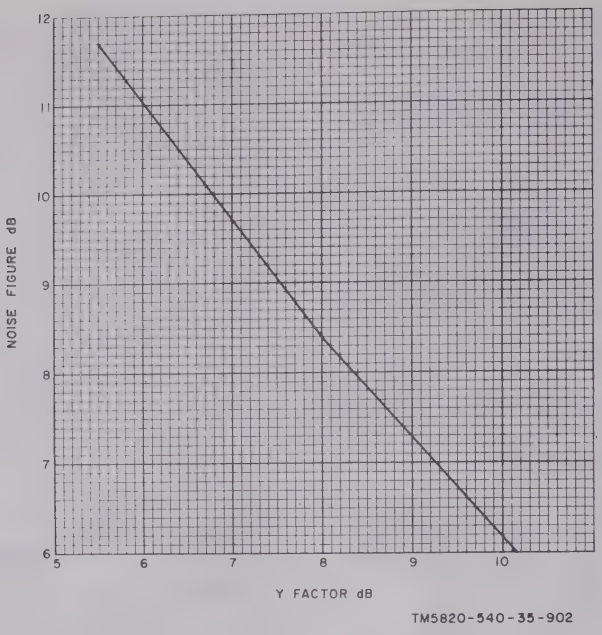

Figure 4–269. Y-factor to noise figure conversion chart for frequency mixer stage 33A7.

c. Troubleshooting (fig. 7–9).

Symptom	*Probable cause*	*Checks and corrective measures*
1. No 30 MHz IF output (*b*(2) above).	*a.* Faulty RF amplifier 37A7A1AR1 (fig. 4–270).	*a.* Check RF amplifier input vswr (*b*(1) above). If outside limits, replace faulty 33A7A1AR1.
	b. Faulty local oscillator input circuits.	*b.* Check local oscillator input vswr; if higher than 3.0:1, check for broken connection in the rigid cable. Replace faulty I/C monitor-power 33A7A1A1.
	c. Broken wires, unsoldered joints, loose connections.	*c.* Visually check for open connections.
	d. Both balanced mixers faulty.	*d.* Replace both balanced mixers 33A7A1-A2 and 33A7A1A3.
2. Low conversion gain (*b*(2) above).	*a.* One faulty balanced mixer.	*a.* Check image rejection (*b*(2) above). If image level high, check for faulty mixer as follows. Apply a ground to the junction of L1–A and C1, while observing the 30 MHz output (*b*(2)(*f*). If a 5–6 db drop in level is observed, 33A7A1A3 is faulty. If no drop in level is observed then 33A7A1A2 is faulty. Apply a ground to the junction of L1–B and C2 and confirm the faulty mixer.
3. High noise figure across the band (*b* (2) above)	Faulty RF amplifier 33A7A1AR1.	Replace faulty 33A7A1AR1 module.
4. No local oscillator metering voltage.	Faulty I/C monitor-power 33A7A1A1.	Replace faulty 33A7A1A1 module.

4–133. Intermediate Frequency Amplifier 33AR1 or 34AR1

a. Test Equipment and material Required.

Equipment	*Common name*
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test faculity
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit

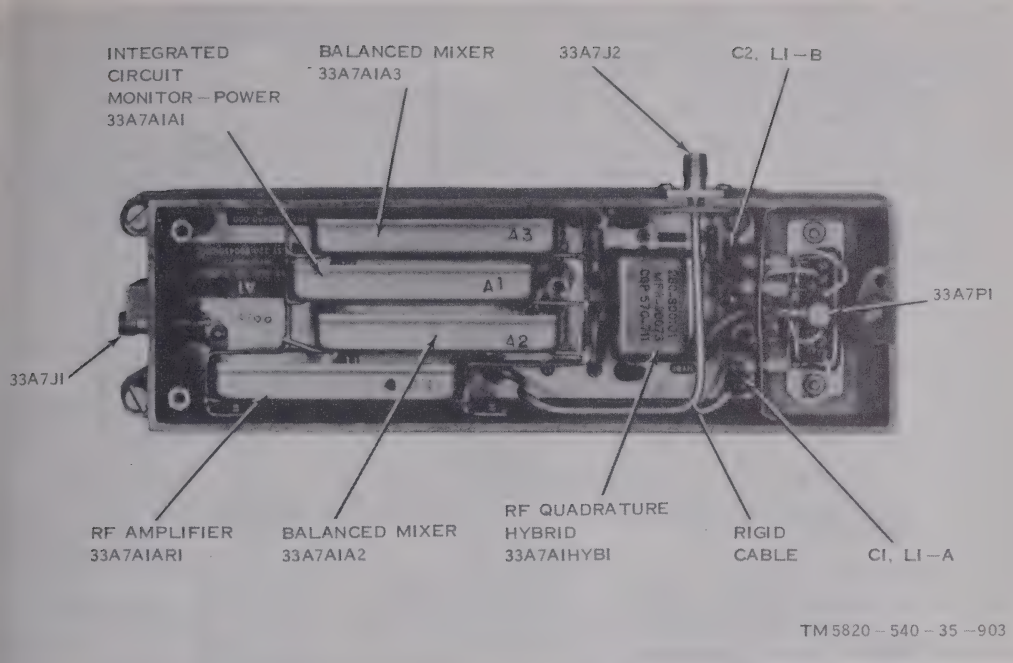

Figure 4–270. Frequency mixer stage 33A7 with cover removed.

Equipment	*Common name*
Oscilloscope AN/USM–281	Oscilloscope
Generator, Sweep SG–888	Sweep generator
Generator, Thermal Noise SG–419/U.	Low frequency noise generator.
Wattmeter AN/URM–98	Power meter
Voltmeter, Digital AN/GSM–64.	Digital voltmeter (DVM)
Vswr Bridge ANZAC RB–3	Vswr bridge RB–3
Dummy Load, Telonic TM–1–1.30F.	Calibrated mismatch TRM–1–1.30F.
Dummy Plate SAC–SK–008	Dummy plate
Multimeter TS–352B/U	Multimeter
Adapter-Connector Omni Spectra 21190.	Adapter connector OS21190
Adapter-Connector 874–QBJL (2 required).	
Adapter-Connector 874–QNJL (2 required).	
Adapter-Connector 874–QBJA	
Cable Assembly, Special Purpose, Electrical SAC–SK–001.	
Power Supply Lambda LP–412FM.	Variable power supply
Voltmeter, Electronic ME–247/U.	RF voltmeter
Low Noise IF Amplifier SM–C–696029.	
30-MHz Gaussian Filter SM–A–698149	
Tektronix Clip Lead, 013–0076–00.	Clip lead
Unit IF Amplifier General Radio Model 1216–A.	Unit IF amplifier

b. Test and Alignment Procedures.

NOTE

Remove the cover plate on the unit under test and install the dummy plate.

(1) *Input and output vswr checks.*

(*a*) Connect the test equipment as shown in A, figure 4–281.

(*b*) Set the sweep generator attenuators to 0 db. Adjust the sweep generator controls for a sweep output from 27 to 33 MHz at 0 dbm as indicated on the power meter. Set the sweep generator attenuators for 50 db.

(*c*) Connect the test equipment as shown in B, figure 4–281.

Figures 4–271 through 4–280. Deleted.

(Next printed page is 4–335)

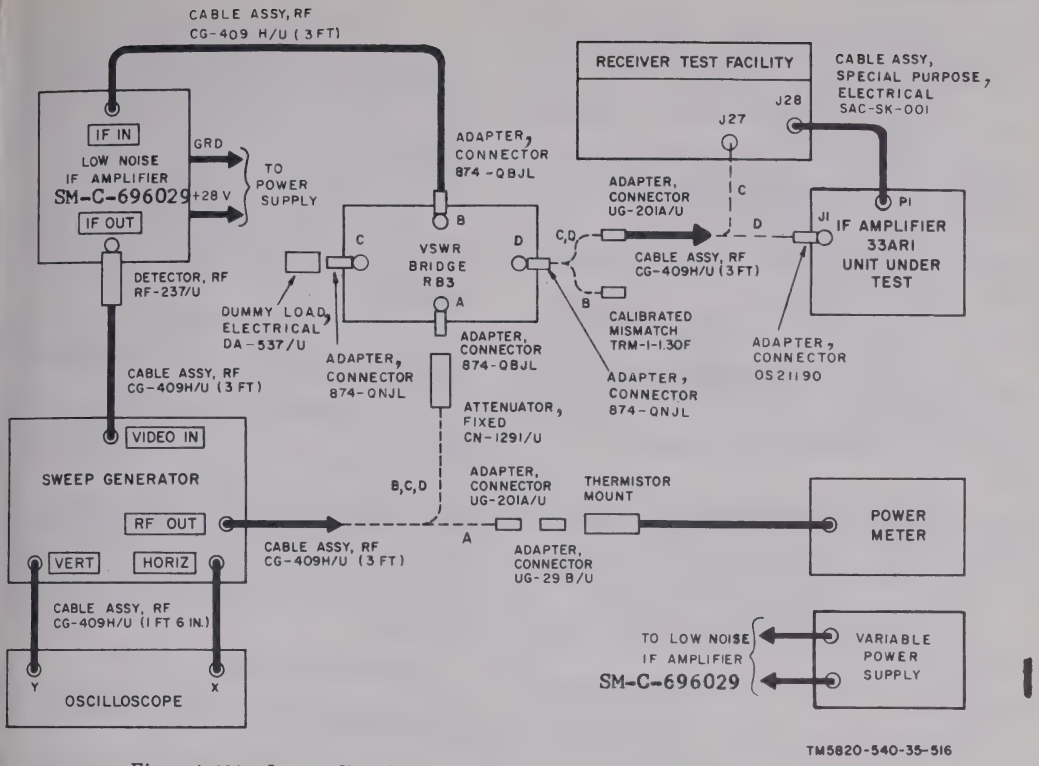

Figure 4-281. Intermediate frequency amplifier 33/34AR1 vswr checks, test setup.

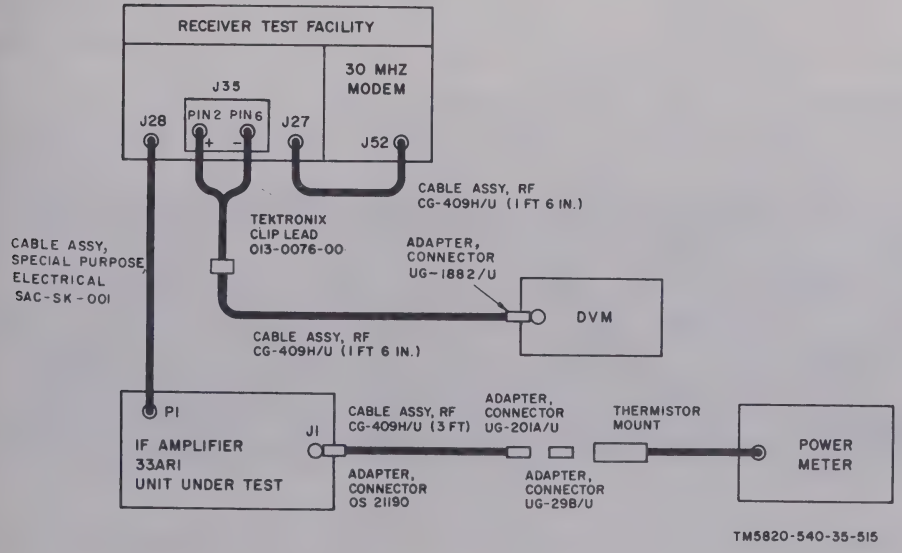

Figure 4-282. Intermediate frequency amplifier 33/34AR1 g ain and agc checks, test setup.

(*d*) Set the test facility switches S1 to ON, S2 to AMPL IF, and S13 to AGC. Adjust the variable power supply to +28v dc.

(*e*) Calibrate the oscilloscope for a vswr of 1.3:1.

(*f*) Connect the test equipment as shown in C, figure 4–281. The input vswr as viewed on the oscilloscope should not exceed 1.3:1.

(*g*) If necessary adjust L1, L2 and L3 (fig. 4–283, for minimum vswr within the frequency range of 28 to 32 MHz.

(*h*) Set the sweep generator attenuators to 0 db and repeat steps (*c*) and (*e*) above.

(*i*) Connect the test equipment as shown in D, figure 4–281. The output vswr as viewed on the oscilloscope should not exceed 1.3:1. If necessary adjust L11 in amplifier IF 33AR1AR1 (fig. 4–285).

(*j*) Set the test facility switch S13 to MAN. and vary the GAIN control from the fully counterclockwise to the fully clockwise position. The vswr response should not exceed 1.3:1 limit.

(2) *Gain and agc checks.*

(*a*) Connect the test equipment as shown in figure 4–282.

(*b*) Set the receiver test facility switches as follows:

Switch	Position
S12	AMPL IF.
S9	30 MHZ
S14	30 MHZ
AT1	60
S13	MAN.

(*c*) Set the receiver test facility switch S1 to ON and adjust the GAIN control on the AMPLIFIER IF. AMPL FREQ MULT section for a 10.0 vdc indication on the DVM. The power meter should indicate between —7 and —13 dbm. If necessary, adjust R4 (fig. 4–283) for a —10 dbm indication on the power meter.

(*d*) Adjust the GAIN control for a 10.7 vdc indication on the DVM and turn AT1 to 30.

(*e*) The power meter should indicate —20 dbm or lower.

(*f*) If the indication is high in (*e*) above, readjust R4 to obtain a —20 dbm indication on the power meter.

(*g*) Repeat (*b*) through (*f*) above, adjusting R4 until the power level requirements of (*c*) and (*e*) are met.

(*h*) If the power level requirements of (*c*) and (*e*) can not be met, turn AT1 to 50 and set the GAIN control for 9.63 vdc on the DVM. Adjust R2 (fig. 4–283) until the power meter indication just starts to decrease then repeat (*b*) through (*g*) above.

(3) *Bandwidth checks.*

(*a*) Connect the test equipment as shown in A, figure 4–283.1.

(*b*) Set the sweep generator attenuators to 0 db. Adjust for a sweep output from 27 to 33 MHz, at an output level of 0 dbm as indicated on the power meter.

(*c*) Set the sweep generator attenuators

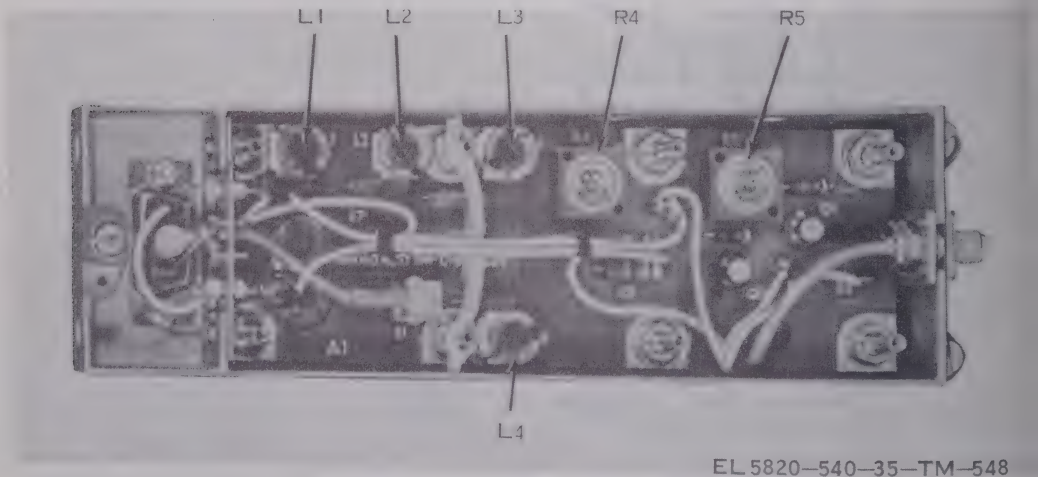

Figure 4–283. Intermediate frequency amplifier 33/34AR1 top view, showing amplifier-filter 33AR1A1 board.

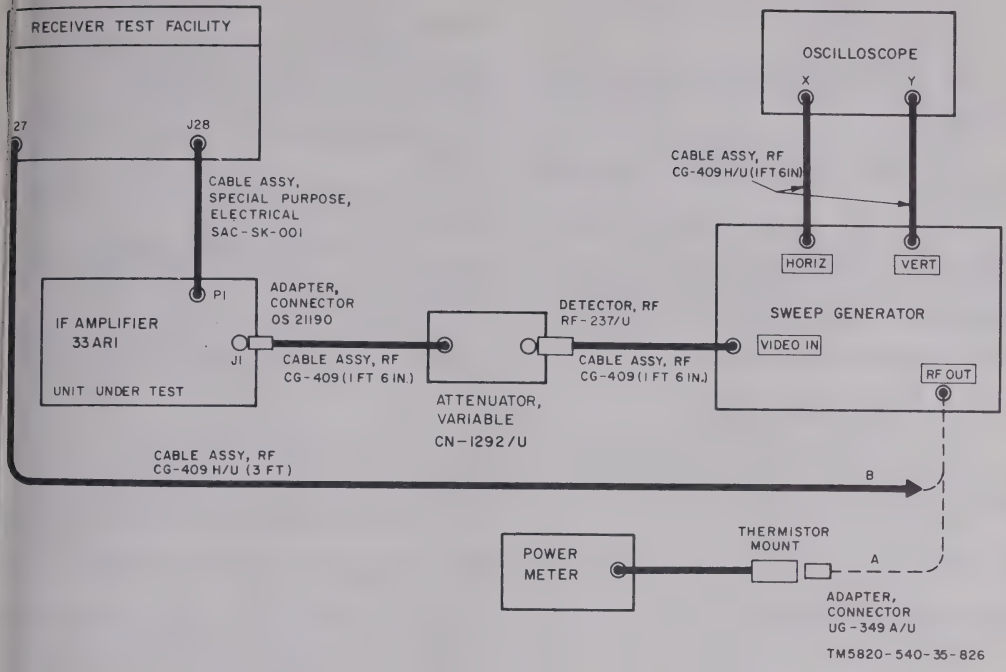

Figure 4-283.1 Intermediate frequency 33/34AR1 bandwidth check, test setup.

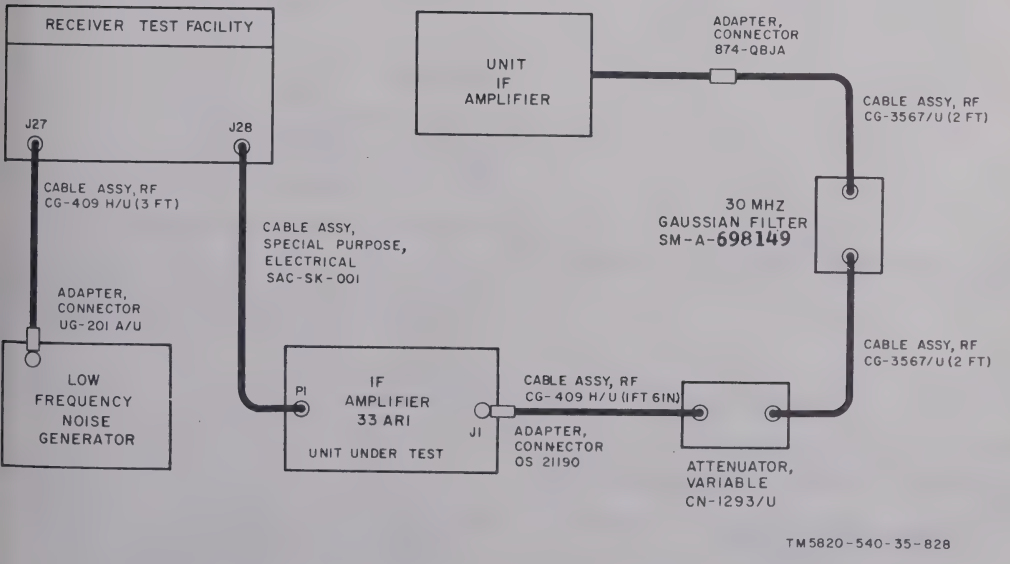

Figure 4-284. Intermediate frequency amplier 33/34AR1 noise figure check, test setup.

for 50 db and connect the test equipment as shown in B, figure 4-283.1.

(*d*) Set the test facility switch S13 to AGC. Adjust the oscilloscope controls for a suitable display.

(*e*) Turn the variable attenuator to 1 db. Draw a line through the peak of the response on the oscilloscope.

(*f*) Turn the variable attenuator to 0 db. The bandwidth, between the two points where the response cuts the 1 db reference line established in (*e*) above, should not be less than 5 MHz.

(4) *Noise figure measurement.*

(*a*) Connect the test equipment as shown in figure 4-284.

(*b*) Set the test facility switches S1 to ON, S12 to AMPL IF. and S13 to AGC.

(*c*) Set the variable 10 db attenuator to 1 db and note the indication on the unit IF amplifier meter.

(*d*) Set the variable attenuator to 4 db and switch on the noise generator.

(*e*) Adjust the noise generator output to obtain the same unit IF amplifier meter indication noted in (*c*) above.

(*f*) The noise figure indicated on the noise generator minus 1 db should not exceed 3.5 db.

c. Troubleshooting (fig. 7-12).

Symptom	Checks and corrective measures
High input vswr	Check the resistance of Q1 (fig. 4-285) (33/34AR1AR1Q1) and components of Q1 base circuit. Replace components as required.
High output vswr	Check the resistance of Q3 and components of Q3 collector circuit. Replace components as required.
Low gain or no output (*b*(2)(*e*) above)	*a.* Check the dc voltages in *d* below. Investigate any abnormal indication. Replace components as required. *b.* Check for damaged cables or connectors and broken wires. Repair or replace as required. *c.* Check the forward and reverse resistance of diodes CR1 and CR2. Replace if required. *d.* Set the test facility attenuator AT1 to 60 db and the GAIN control to indicate 10.0 vdc on the DVM. Check the signal at test points indicated below. *Test points* — *Typical indication (volts rms)* 33/34AR1AR1Q1—base 0.004 —collector 0.01 33/34AR1AR1Q2—base 0 —collector 1.7 33/34AR1AR1Q3—base 0 —collector 0.08 Check components in isolated stage and replace as required.
Signal requirements not met in step *b*(2)(*f*) above (abnormal AGC action).	Set the test facility attenuator AT1 to 30 db and adjust GAIN control for a 10.7 vdc indication on the DVM. Check the dc voltages at Q1 and Q2 (33/34AR1A1) and the catholes of CR1 and CR2 as established in *d* below. Check the components in isolated stage and replace as required.
Excessive noise	Check for poor solder joints and/or ground connections on the printed circuit boards. Replace 33/34AR1AR1Q1 and/or 33/34AR1AR1Q2.

d. Voltage and Resistance Measurements (fig. 4-285).

(1) *Voltage measurements.*

NOTE

Use the allocated multimeter for voltage and resistance measurements. Dc voltage measurements referenced to ground. (Test facility attenuator set to 30 db and GAIN control adjusted for 10.7 vdc indication on DVM as in (*b*)(2) above.)

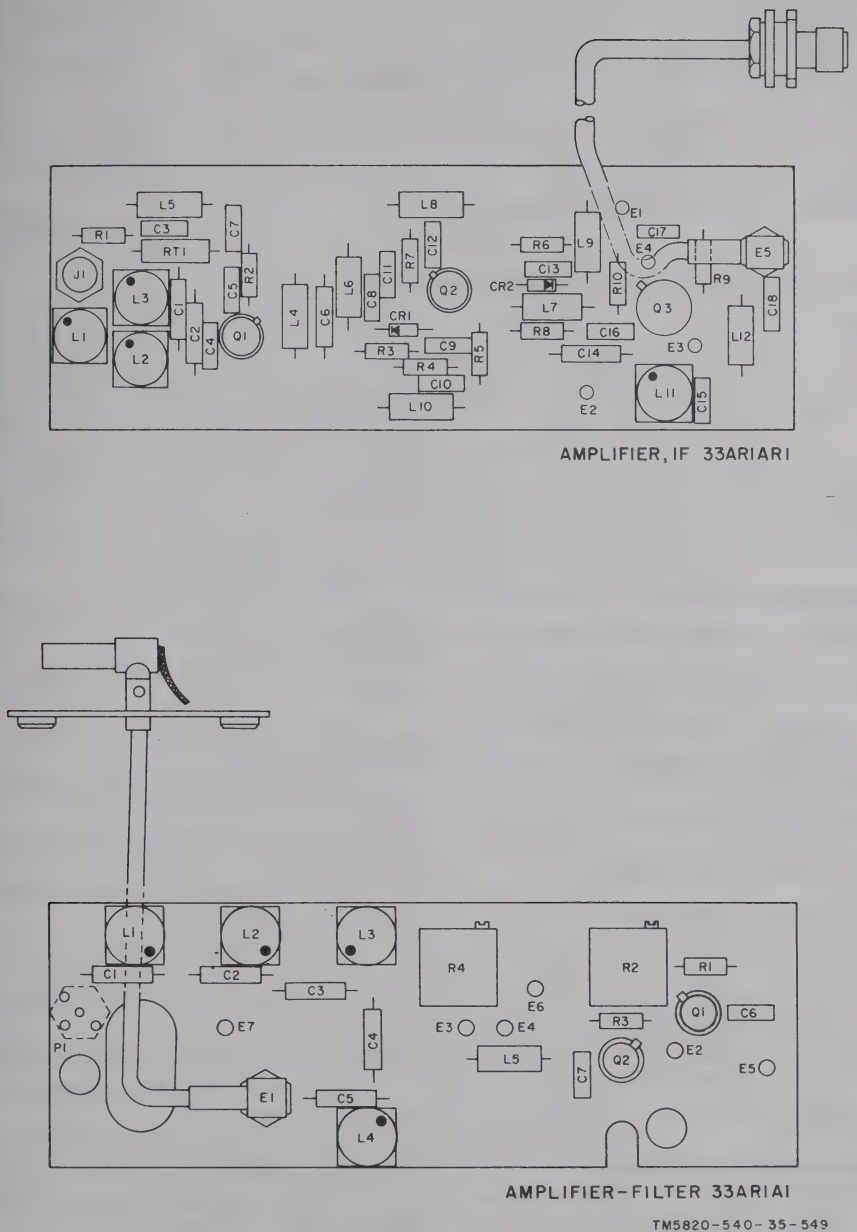

Figure 4-285. Intermediate frequency amplifier 33AR1 or 34AR1 parts location.

Test points	Typical indication (volts dc)
33/34AR1A1Q1—base	−10.10
—emitter	−6.20
—collector	0
33/34AR1A1Q2—base	−5.60
—emitter	−6.20

Test points	Typical indication (volts dc)
33/34AR1AR1Q1—base	−5.65
—emitter	−6.40
33/34AR1AR1Q2—base	−8.70
—emitter	−9.43
33/34AR1AR1Q3—base	−8.63
—emitter	−9.52

(2) *Transistor in-circuit resistance measurements.*

NOTE

All resistances measured with the allocated multimeter.

Stage	Base (−)				Base (+)			
	Emitter (+)		Collector (+)		Emitter (−)		Collector (−)	
	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range
33/34AR1A1Q1	925	X 100	Inf	X 10,000	730	X 100	750	X 100
33/34AR1A1Q2	Inf	X 10,000	Inf	X 10,000	860	X 100	820	X 100
33/34AR1AR1Q1	7.2k	X 100	2.1k	X 100	1.1k	X 100	1.1k	X 100
33/34AR1AR1Q2	4.4k	X 100	4.8k	X 100	1.16k	X 100	1.1k	X 100
33/34AR1AR1Q3	2.2k	X 100	3.0k	X 100	925	X 100	900	X 100

4–134. Amplifier-Filter 33AR1A1 or 34AR1A1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Test Facility, Receiver TS–2866(V)1/GRM–95(V).	Receiver test facility
Voltmeter, Vector Hewlett-Packard 8405A.	Vector voltmeter
Accessory, Kit, Vector Voltmeter Hewlett-Packard 11570A.	50-ohm loads and 50 ohm 'T's.
Generator, Signal SG–409( )/U.	Signal generator No. 1
Oscilloscope AN/USM–281	Oscilloscope
Generator Sweep SG–888	Sweep generator
Low Pass Filter SM-C 696031.	
Cable Assembly, Special Purpose Electrical SAC–SK–001.	
Shorting Tool SAC–SK–007	Shorting tool
Filter Shield Assembly SAC–SK–024.	Filter shield assembly

b. Test Procedures.

(1) *Vswr check.*

(*a*) Place unit under test into the filter shield assembly and connect the test equipment as shown in A, figure 4–286.

(*b*) Adjust the sweep generator controls to obtain a sweep between 27 and 33 MHz at maximum leveled output.

(*c*) Calibrate the oscilloscope for a vswr of 1.10:1.

(*d*) Connect the test equipment as shown in B, figure 4–286.

(*e*) The filter input vswr displayed on the oscilloscope should be less than 1.10:1.

(*f*) Connect the test equipment as shown in C, figure 4–286.

(*g*) The filter output vswr displayed on the oscilloscope should be less than 1.10:1.

(*h*) If necessary, slightly adjust L1, L2, L3 and L4 (fig. 4–285) and repeat steps (*d*) through (*g*) above to meet the input and output vswr requirements.

(2) *Insertion loss and rejection check.*

(*a*) Connect the test equipment as shown in A, figure 4–287.

(*b*) On the receiver test facility turn switch S12 to AMPL IF. and set S1 to ON.

(*c*) Set the coaxial switch to position 2 and set the variable attenuator to 0.

(*d*) Set signal generator No. 1 to 30 MHz and adjust the output level for an indication of —10 dbm on vector voltmeter channel B.

(*e*) Turn the coaxial switch to position 1.

(*f*) Adjust the variable attenuator for —10 dbm indication on the vector voltmeter channel

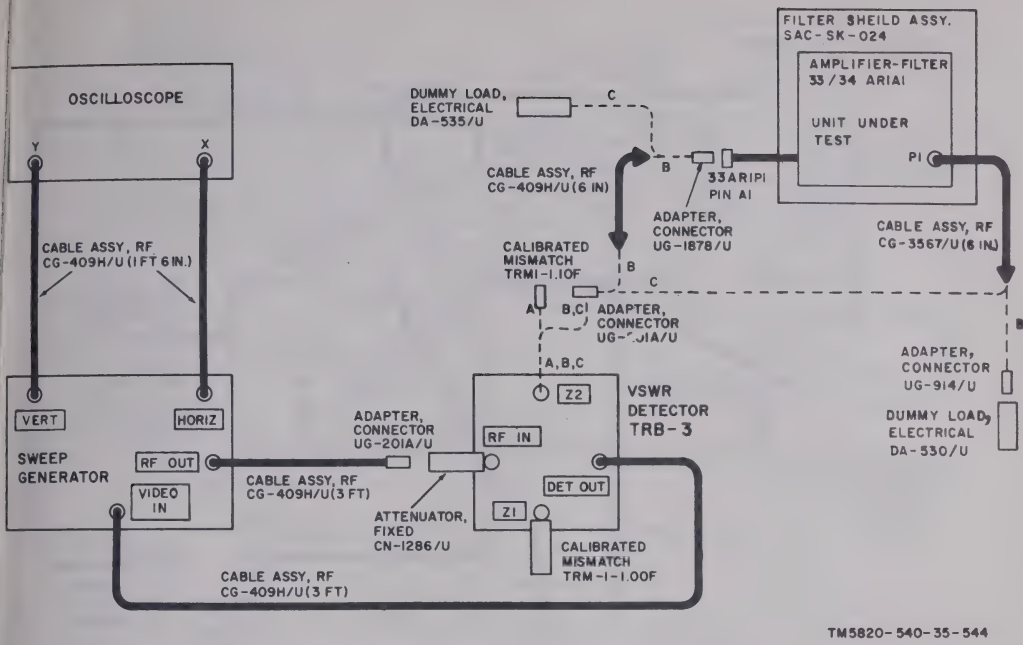

Figure 4–286. Amplifier-filter 33/34AR1A1 vswr check, test setup.

3. The insertion loss as indicated on the variable ttenuator should be 0.6 db or less.

(*g*) Repeat steps (*c*) through (*f*) above for ignal generator frequencies of 27 MHz and 33 MHz; the insertion loss should be 0.9 db or less.

(*h*) Connect the test equipment as shown n B, figure 4–287. Reset the variable attenuator o 0 db and turn the coaxial switch to position 1.

(*i*) Set the signal generator to 15 MHz and djust the level control to obtain —10 dbm indica- ion on the vector voltmeter channel B.

(*j*) Turn the coaxial switch to position 2. The vector voltmeter channel B indication should e —55 dbm or lower, indicating filter rejection f 45 db or greater.

c. Troubleshooting and Alignment Procedures. Check capacitors C1, C2, C3, C4 and C5 and coils L1, L2, L3 and L4 (fig. 4–285) using a universal ridge. If any component is changed, do the fol- owing preliminary alignment procedure before epeating *b*(1) above.

(1) Connect the test equipment as shown in A, figure 4–286.

(2) Adjust the sweep generator controls for maximum output level between 20 and 40 MHz.

(3) Connect the test equipment as shown in B, figure 4–286.

(4) Adjust the sweep generator to display a sweep between 18.5 and 28.5 MHz.

(5) Using the shorting tool, short circuit L3 and adjust L4 to obtain a null in the response at 23.5 MHz.

(6) Connect the test equipment as shown in C, figure 4–286.

(7) Using the shorting tool, short circuit L2 and adjust L1 to obtain a null in the response at 23.5 MHz.

(8) Adjust the sweep generator to display a sweep between 23.5 and 43.5 MHz.

(9) Using the shorting tool, short circuit L3 and adjust L2 for a null in response at 38.5 MHz.

(10) Connect the test equipment as shown in B, figure 4–286.

(11) Using the shorting tool, short circuit L2 and adjust L3 for a null in response at 38.5 MHz.

(12) With L2 shorted, a second null should appear at approximately 22 MHz.

(13) Connect the test equipment as shown in C, figure 4–286.

(14) Using the shorting tool, short circuit L3. A null should appear at approximately 22 MHz.

(15) Repeat *b*(1) above.

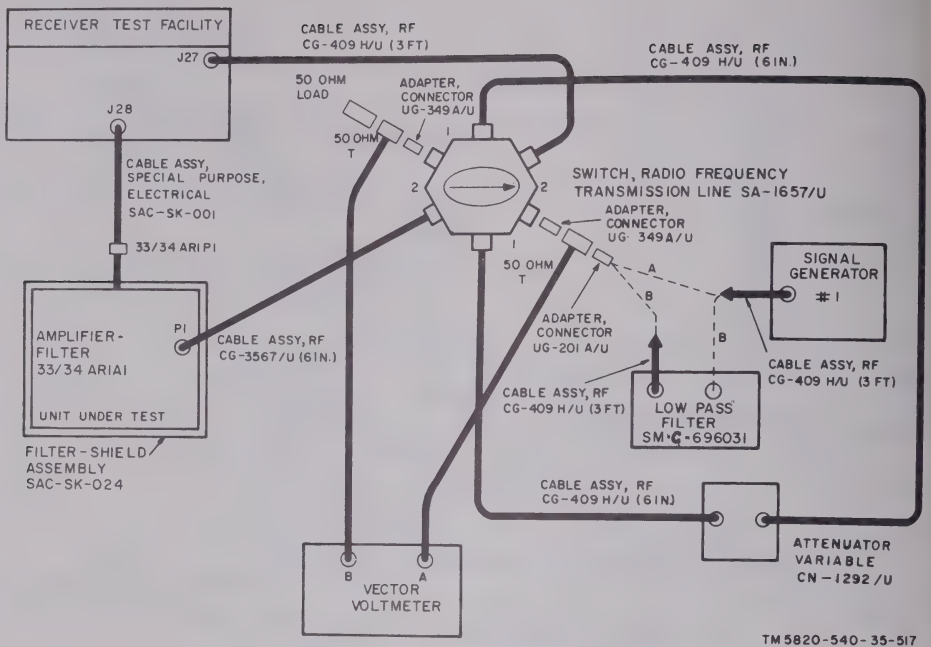

Figure 4–287. Amplifier-filter 33/34AR1A1 insertion loss and rejection check, test setup.

4–135. Low Pass Filter 33FL1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Oscilloscope AN/USM–281	Oscilloscope
Generator, Sweep SG–888	Sweep generator
Low-Pass Filter, Telonic TLC–705–8EF.	Filter TLC–705–8EF
Indicator, Standing Wave Radio AN/UPM–108.	Vswr indicator
Generator, Signal SG–340A/G.	Signal generator No. 2
Adapter-Connector Omni Spectra 21030.	Adapter-connector OS21030
Adapter-Connector Omni Spectra 21190 (2 each).	Adapter-connector OS21190
Adapter-Connector Omni Spectra 21200.	Adapter-connector OS21200

b. Test Procedures.

(1) *Vswr check.*

(*a*) Connect the test equipment as shown in A, figure 4–288.

(*b*) Adjust the sweep generator controls to provide a sweep between 395 and 705 MHz.

(*c*) Adjust the oscilloscope controls and the sweep generator attenuator dial for a convenient display. Record the resultant display on the graticule of the oscilloscope. This represents a vswr of 1.25:1.

(*d*) Connect the test equipment as shown in B, figure 4–288.

(*e*) The input vswr of the unit under test displayed on the oscilloscope should not exceed 1.25:1.

(*f*) Reverse the input and output connections to the unit under test.

(*g*) The output vswr of the unit under test displayed on the oscilloscope should not exceed 1.25:1.

(2) *Insertion loss in the pass-band check.*

(*a*) Connect the test equipment as shown in B, figure 4–289.

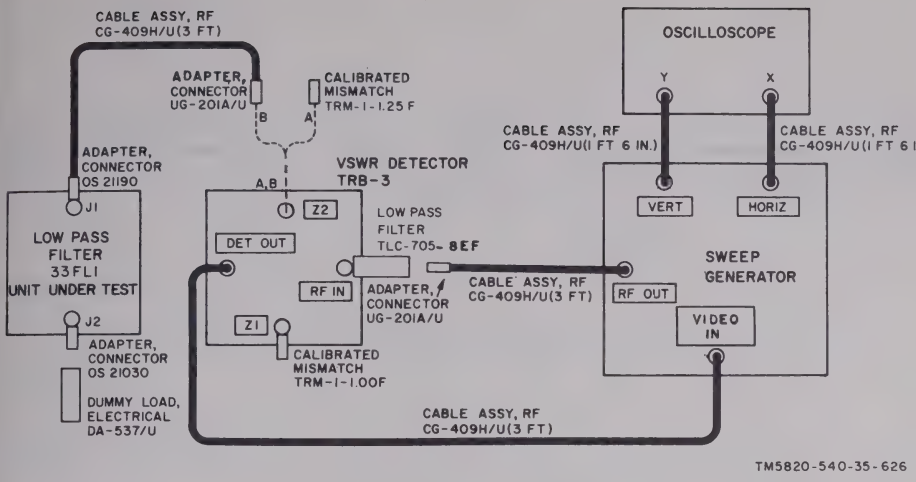

Figure 4–288. Low-pass filter 33FL1 vswr check, test setup.

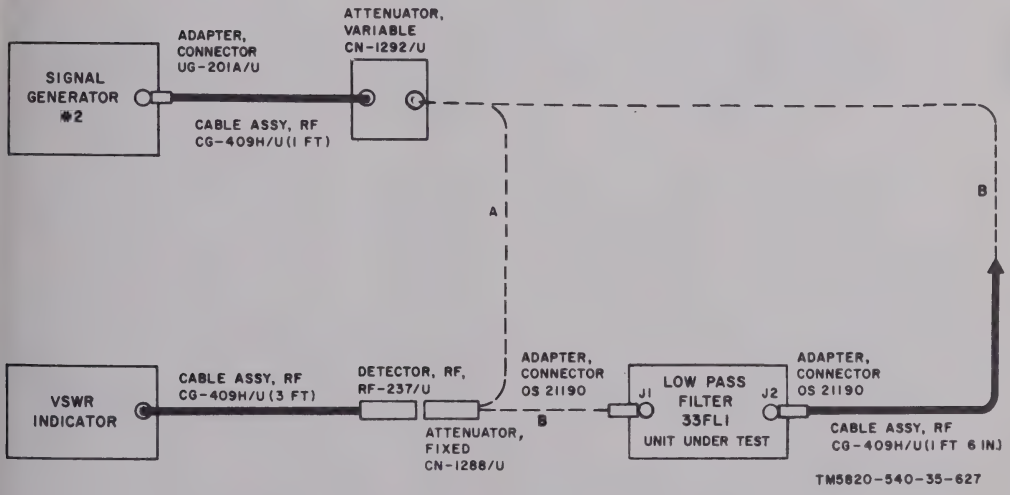

Figure 4–289. Low-pass filter 33FL1 insertion loss check, test setup.

(*b*) Set the variable attenuator dials to 0 b.

(*c*) Adjust signal generator No. 2 controls provide maximum output at a frequency of 450 Hz modulated with 1000 Hz at a level of 30 ercent.

(*d*) Adjust the swr indicator controls for a onvenient indication. Record this reading.

(*e*) Connect the test equipment as shown A, figure 4–289.

(*f*) Adjust the variable attenuator (0–1 db) to obtain the indication recorded in step (*d*) above. The added attenuation is equivalent to the insertion loss of the unit under test and should be 0.3 db or less.

(*g*) Repeat steps (*a*) through (*f*) above for a signal generator No. 2 frequency of 700 MHz.

(3) *Out-of-band rejection.*

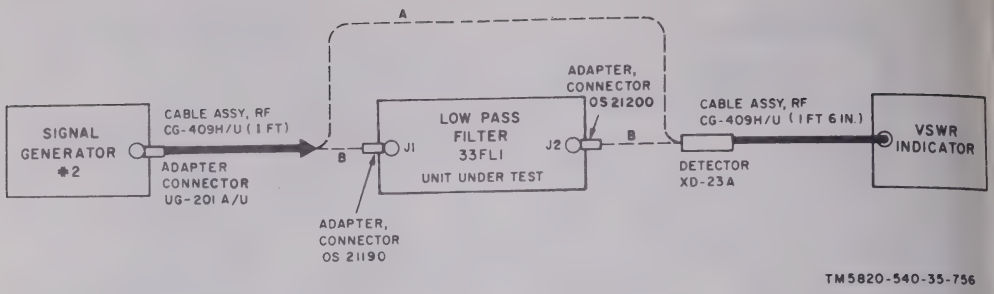

Figure 4-290. Low-pass filter 33FL1 out-of-band rejection, test setup.

Figure 4-291. Power supply 33PS1 or 34PS1, test setup. Deleted.

(*a*) Connect the test equipment as shown in A, figure 4-290.

(*b*) Calibrate signal generator No. 2 for 0 dbm output level. Set signal generator No. 2 output attenuator to —35 dbm and the frequency to 1200 MHz modulated with 1000 Hz at a level of 30 percent.

(*c*) Adjust the vswr indicator for a convenient indication and note the indication.

(*d*) Connect the test equipment as shown in B, figure 4-290.

(*e*) Set signal generator No. 2 outpu attenuator to 0 dbm. The vswr indicator readin should be less than that noted in (*c*) above ind cating rejection of 35 db or greater.

NOTE

This unit is expendable. If any of the above tests indicate that the unit is defective, discard the unit.

4136. Power supply 33PS1 or 34PS1.

Deleted.

Section VI. RADIO SET ALIGNMENT PROCEDURES—BAND II

4-137. Transmitter Radio T-983(P)/GRC-103(V) and Amplifier-Frequency Multiplier AM-4321/GRC-103(V) (Transmitter Fixed and RF Heads) Tests and Alignment

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set, MK-1173(V)1/GRM-95(V).	Accessory Kit
Voltmeter Electronic ME-30A/U.	VTVM
Generator, Signal AN/USM-205.	Wide range oscillator
Generator, Signal SG-409( )/U.	Signal generator No. 1
Generator, Signal 340A/G.	Signal generator No. 2
Selective Voltmeter AN/USM-306.	Level meter
Wattmeter AN/URM-120	Wattmeter
Frequency Meter AN/USM-159.	Frequency Meter
Multimeter TS-352B/U	Multimeter
Wave Analyser Bruel and Kjoer 2107.	Wave Analyser
Trombone Line General Radio 874-LTL.	Trombone line 874-LTL
Wattmeter AN/URM-98	Power meter
Cable Assembly, Special Purpose, Electrical CX-10762/GRC-103(V).	
Cable Assembly, Special Purpose, Electrical CMC 217-800010 (fig. 5-18).	
Adapter-Connector 874-QNJL (2 required).	
Adapter-Connector UG-564A/U.	
Short circuit Plug, Microlabs TS-5MC.	Short circuit plug.

b. Test Procedures.

(1) *Preliminary operational checks.*

(*a*) Connect the test equipment as shown in A, figure 4-294.

(*b*) Set the voltage control on the power supply (part of the accessory kit) to 115v ac.

(*c*) Set the unit under test AC POWER switch to ON/RESET. Observe the following on the unit under test:

1. Buzzer may sound; press BUZZER OFF switch to silence the buzzer.

2. Blower should operate.

3. AC POWER lamp should light.

4. If the SYNC alarm lamp lights, i should extinguish within 10 seconds.

5. LOW POWER alarm lamp shoul light.

(*d*) Check the unit under test meter indica tions at the following meter selector switch posi tions:

Switch position	Typical indication
12V DC	In the green band
28V DC	In the green band
600V DC	In the green abnd
OSC	20% to 90% full scale

(*e*) On the unit under test, set the XMTI CHANNEL and XMTR TUNE controls t channel 390.

(*f*) Check the unit under test meter indica tions at the following meter selector switch posi tions:

Switch position	Typical indication
DOUBLER	20% to 90% of full scale
MULT	20% to 90% of full scale

(*g*) Set the meter selector switch t DRIVER. Tune the XMTR TUNE control fo maximum meter indication. The unit under tes meter should indicate 20 to 90 percent of fu scale.

(*h*) Set the meter selector switch to PWI OUT. Tune the PWR OUT PEAK knob for maxi mum meter indication. The unit under test mete should indicate 20 to 90 percent of full scale. I the indication is greater than 100 percent of fu scale, observe the wattmeter for maximum indica tion.

(*i*) The unit under test LOW POWE lamp should go out and the buzzer should sound Press the BUZZER OFF pushbutton to silenc the buzzer.

NOTE

The unit under test XMTR TUNE control can be readjusted slightly (not to exceed ½ inch movement on the XMTR TUNE tape) to peak the meter indications.

(*j*) Set the AC POWER switch to OFF.

(*k*) Remove the transmitter RF head fron the transmitter case and use extension cabl

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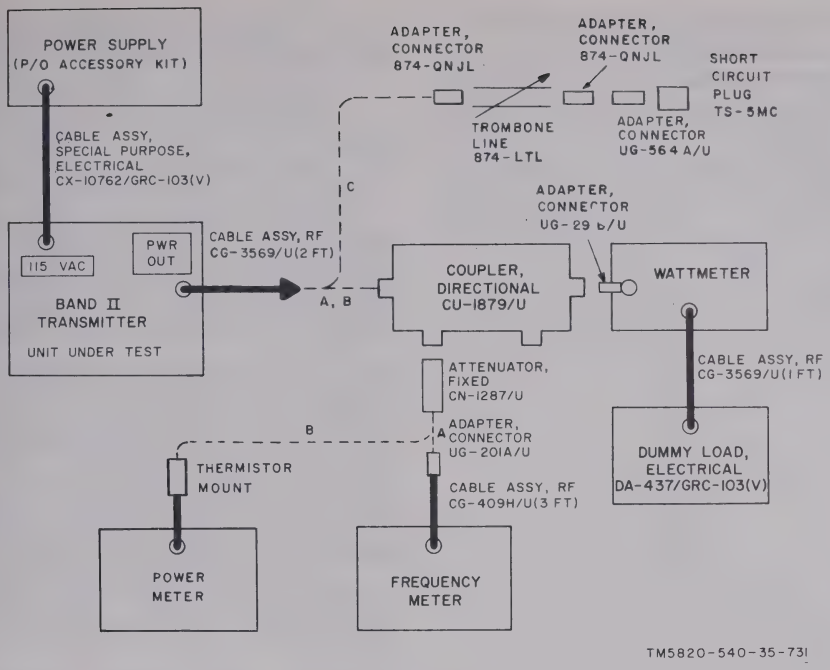


Figure 4–294. Band II transmitter operational check, test setup.

ER–12028/U (1 ft 3 in.) to reestablish connections.

(*l*) Not used.

(*m*) Set the AC POWER switch to ON/RESET.

(*n*) Set the meter selector switch to PWR OUT and observe the unit under test meter. Readjust the PWR OUT PEAK control for peak power as in (*h*) above.

(*o*) Locate and remove the access door on the right-hand side of the transmitter RF head dust cover (fig. 1–3) to allow access to the test points on the voltage regulator assembly A7AR1A1A1.

(*p*) Use the multimeter to check the heater voltages as shown below and record the indications.

	Connect multimeter between	Voltage reading (v dc)	Multimeter range
Heater voltage:			
Driver amplifier	TP1(−) and TP3(+).	6.0 to 6.4	10v dc
Output amplifier	TP2(−) and TP4(+).	6.0 to 6.4	

(*q*) Set the AC POWER switch to OFF and reinstall the transmitter RF head in the transmitter case.

(*r*) Set the AC POWER switch to ON.

(*s*) Set the meter selector switch to PWR OUT. Record the unit under test meter indication.

(*t*) Set the meter selector switch to REFL PWR; the unit under test meter indication should be less than 10 percent of full scale.

(*u*) Temporarily disconnect the cable from the unit under test PWR OUT connector; the meter should indicate a level nearly equal to that obtained in (*s*) above.

(2) *RF output power measurement.*

(*a*) Use the test setup shown in A, figure 4–294.

(*b*) On the unit under test set the XMTR CHANNEL and XMTR TUNE controls to channel 390.

(*c*) Tune the unit under test to peak power as described in (1)(*g*) and (*h*) above.

(*d*) Check the wattmeter indication; it should be at least 25 watts.

(*e*) Set the voltage control on the power

supply (part of the accessory kit) to 105v ac. The wattmeter should indicate at least 25 watts.

(*f*) Set the voltage control on the power supply to 125v ac. The wattmeter should indicate at least 25 watts.

(*g*) Reset the voltage control on the power supply to 115v ac.

(*h*) Repeat (*b*) through (*g*) above for every test channel listed below.

Channel	Frequency (MHz)
390	395
400	400
480	440
560	480
640	520
720	560
759	579.5
760	580
800	600
880	640
960	680
1000	700
1010	705

(*i*) Disconnect the power supply from the 60-Hz supply and connect it to a 400-Hz supply.

(*j*) Repeat (*b*) through (*g*) above for every test channel listed above. The wattmeter should indicate at least 25 watts.

(*k*) Reconnect the power supply to the 60-Hz supply.

(3) *Low-power alarm operating level measurements.*

(*a*) Use the test setup shown in B, figure 4–294.

(*b*) Tune the unit under test to channel 390 and tune for peak output power as described in (1)(*g*) and (*h*) above.

(*c*) Reduce the output power of the unit under test by slowly detuning the PWR OUT PEAK and/or the XMTR TUNE control.

(*d*) Note the power level on the wattmeter at which the LOW POWER alarm lamp lights. It should be between 2.5 w and 6.25 w. The buzzer should sound; press the BUZZER OFF pushbutton to silence the buzzer. Note the power meter indication.

(*e*) Slowly restore the output power. Note the power level on the power meter at which the LOW POWER lamp goes out and the buzzer sounds. Silence the buzzer. The increased power to clear the alarm should be between 3 and 5 db; the power level indicated on the wattmeter should not exceed 10 watts.

(*f*) Repeat (*b*) through (*e*) above for all test channels listed in the chart in (2)(*h*) above.

(4) *Output-tube dissipation check.*

(*a*) Use the test setup shown in B, figure 4–294.

(*b*) Set the voltage control on the power supply to 125v ac.

(*c*) On the unit under test, set the XMTR CHANNEL and XMTR TUNE controls to channel 390 and tune for peak output power as described in (1)(*g*) and (*h*) above. Record the output power as indicated on the wattmeter.

(*d*) Connect the test equipment as shown in C, figure 4–294. Set the meter selector switch to DRIVER. Vary the length of the trombone line for maximum meter indication and leave the transmitter on for 15 minutes.

(*e*) Without changing the length of the trombone line, remove the short circuit plug and leave the transmitter on for another 15 minutes.

(*f*) Reconnect the cable to the directional coupler (A, fig. 4–294). The wattmeter should indicate within 2 watts of the level recorded in (*c*) above.

(*g*) On the unit under test set the XMTR CHANNEL control to channel 759 and the XMTR TUNE control to channel 390. (This effectively removes the transmitter drive.)

(*h*) Set the unit under test meter selector switch to MULT. The meter should indicate less than 10 percent of full scale.

(*i*) Set the unit under test meter selector switch to DRIVER. The meter should indicate less than 15 percent of full scale.

(*j*) Leave the unit under test on for 30 minutes.

(*k*) Set the XMTR CHANNEL and XMTR TUNE controls to channel 390 and tune for peak output power as described in (1)(*g*) and (*h*) above. The wattmeter should indicate within 2 watts of the level recorded in (*c*) above.

(5) *Transmitter frequency check.*

(*a*) Use the test setup as shown in A, figure 4–294.

(*b*) Set the voltage control on the power supply for 115v ac.

(*c*) On the unit under test set the XMTR CHANNEL and XMTR TUNE to channel 400 and tune for peak output power as described in (1)(*g*) and (*h*) above. The counter should indicate 400 MHz ± 8 kHz.

(*d*) Repeat (*c*) above for all test channels

ted in (2)(*h*) above. The frequency accuracy all be within 0.002 percent of nominal frequency (20 Hz per MHz).

(6) *Frequency deviation measurements.*

(*a*) Initial setup. Connect the test equipment as shown in A, figure 4–295.

(*b*) 24-channel deviation measurement.

1. Set transmitter test facility switch S1 to ON and switch S20 to 30 MHz DISCR.

2. On unit under test, set the meter selector switch to 24 CH PCM and the INPUT control to midpoint.

3. On the unit under test, set the XMTR CHANNEL and XMTR TUNE controls to channel 410 and tune for peak output power as described in (1(*g*) and (*h*) above.

4. Adjust the wide range oscillator to 10 kHz and adjust the output level for a transmitter meter indication of 50 percent of full scale.

5. Tune signal generator No. 1 to 375 MHz; set the signal generator attenuator to 0 dbm.

6. Observe test facility meter M1 and fine tune the signal generator for a peak indication. Adjust the attenuator on the signal generator to maintain M1 indication at 50 percent full scale. Tune the signal generator for a midscale indication on test facility meter M2. The deviation as indicated by the unterminated VTVM should be between 260 and 386mv rms (1 mv rms = 1 kHz peak deviation).

(*c*) 12-channel deviation measurement. Using the setup given in (*b*) above, set the unit under test meter switch to 12 CH PCM and adjust the INPUT control for a 50 percent of full scale indication. The deviation as indicated by the unterminated VTVM should be between 156 and 232 mv rms.

(*d*) Order wire deviation measurement.

1. Connect the wide range oscillator and VTVM to the unit under test OW connector as shown in figure 4–295B.

2. Adjust the wide range oscillator ouput for a —10 dbm indication on the VTVM.

3. Reconnect the VTVM to test facility

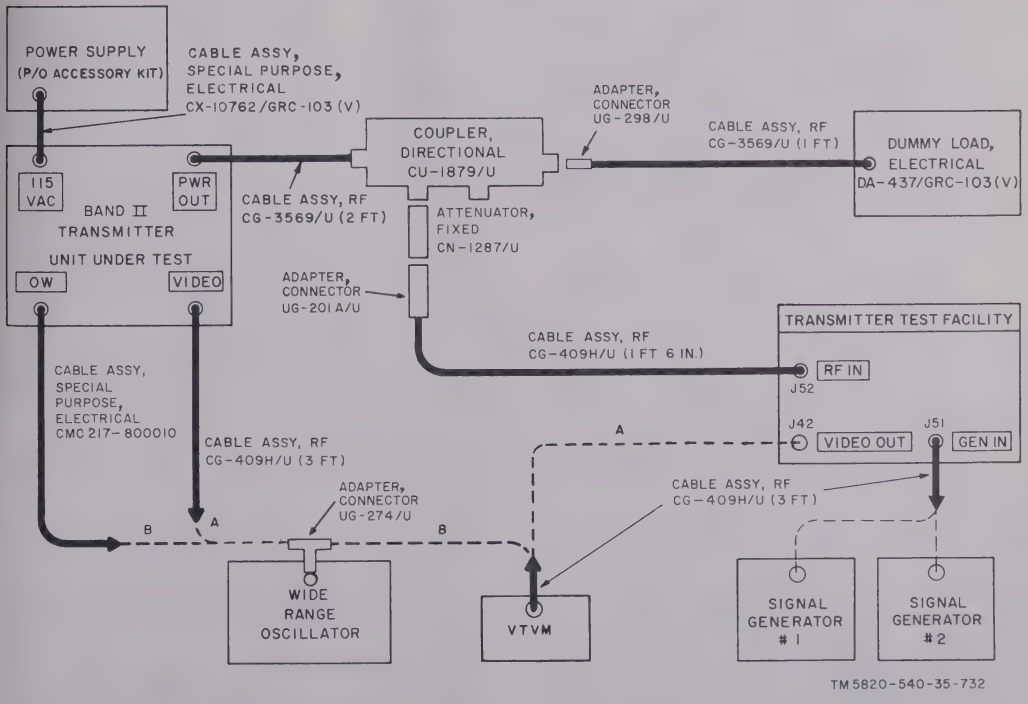


Figure 4–295. Band II transmitter frequency deviation measurements test setup.

connector J42. The VTVM should indicate between 39 and 58 mv rms (1 mv rms = 1 kHz peak deviation).

(*e*) Repeat (*b*) through (*d*) above for the test channels listed in the chart below.

Channel	Signal generator frequency (MHz)
500	420
750	545*
1000	670*

* Use signal generator No. 2.

(7) *Frequency response measurements and spurious outputs in video band.*

(*a*) *Initial calibration.*

1. Connect the test equipment as shown in A, figure 4–296.

2. Set the unit under test XMTR CHANNEL and XMTR TUNE controls to channel 430 and tune for peak output power as described in (1) (*g*) and (*h*) above.

3. Set the coaxial switch to position 1.

4. Tune signal generator No. 1 to 385 MHz at an output of 0 dbm.

5. Set transmitter test facility switch S1 to ON and switch S20 to 30 MHz DISCR.

6. Observe test facility meter M1 and fine tune the signal generator for a peak indication. Adjust the signal generator attenuator to maintain meter M1 at 50 percent of full scale, then tune until a 50 percent of full scale indication is obtained on test facility meter M2. (Both meters M1 and M2 should indicate 50 percent of full scale.)

7. Set the unit under test meter selector switch to FDM.

8. Tune the wide range oscillator to 10 kHz with an output level of 350 mv rms. Adjust the unit under test INPUT control for 65 percent of full scale indication on the unit under test meter (approximately 100 kHz peak deviation).

9. Check the output signal-to-noise ratio as described below. The output signal-to-noise ratio should be at least 20 db at 960 kHz.

(*a*) Tune the wide range oscillator to 960 kHz.

(*b*) Set the frequency of level meter to 960 kHz. Record the level meter indication.

(*c*) Disconnect the wide range oscillator and increase the level meter gain by 20 db. Record the level meter indication; it should not exceed the reading obtained in (*b*) above (with modulating signal on).

(*b*) *Frequency response tests.*

1. Use the test setup as shown in A figure 4–296.

2. Tune the wide range oscillator to 1 kHz.

3. Set the frequency of the level meter t 10 kHz. Record the level meter indication.

4. Set the coaxial switch to position 2.

5. Adjust the variable attenuators t obtain a level meter indication within ± 0.1 db of the level obtained in *3* above. Record the variable attenuator settings. This is the reference level.

6. Repeat *2* through *5* above for all frequencies above 10 kHz listed in the chart below and record the attenuation with respect to the reference level (*5* above).

Wide range oscillator (kHz)	Relative attenuation (db), reference 10 kHz		
	Nominal	Minimum	Maximum
0.125	1.0	0	1.5
0.200	0.5	0	1.0
0.250	0.2	0	0.4
1.0	0	−0.1	0.1
10	0		
30	0	−0.2	0.2
60	0.1	0	0.3
120	0.15	0	0.5
240	0.7	0.5	1.3
360	1.5	1.1	2.3
480	2.7	1.9	3.8
600	4.2	3.0	5.9
720	6.0	4.3	8.6
840	8.2	5.8	12.0
960	10.7	7.6	15.0

7. Replace the level meter with the wave analyzer (B, fig. 4–296) and increase the output level of the wide range oscillator by 10 db. Repeat *2* through *5* above for all frequencies below 10 kHz listed in the chart above.

8. Repeat *2* through *7* above for all test channels listed in the chart below. (Use signal generator No. 2.)

Channel	Signal generator (MHz)
759	579.5
760	580
990	695

(*c*) *Spurious outputs in video band test.*

1. Use the test setup shown in A, figure 4–296.

2. Set the unit under test XMTR CHANNEL and XMTR TUNE controls to channel 460 and tune for peak output power as described in (1) (*g*) and (*h*) above.

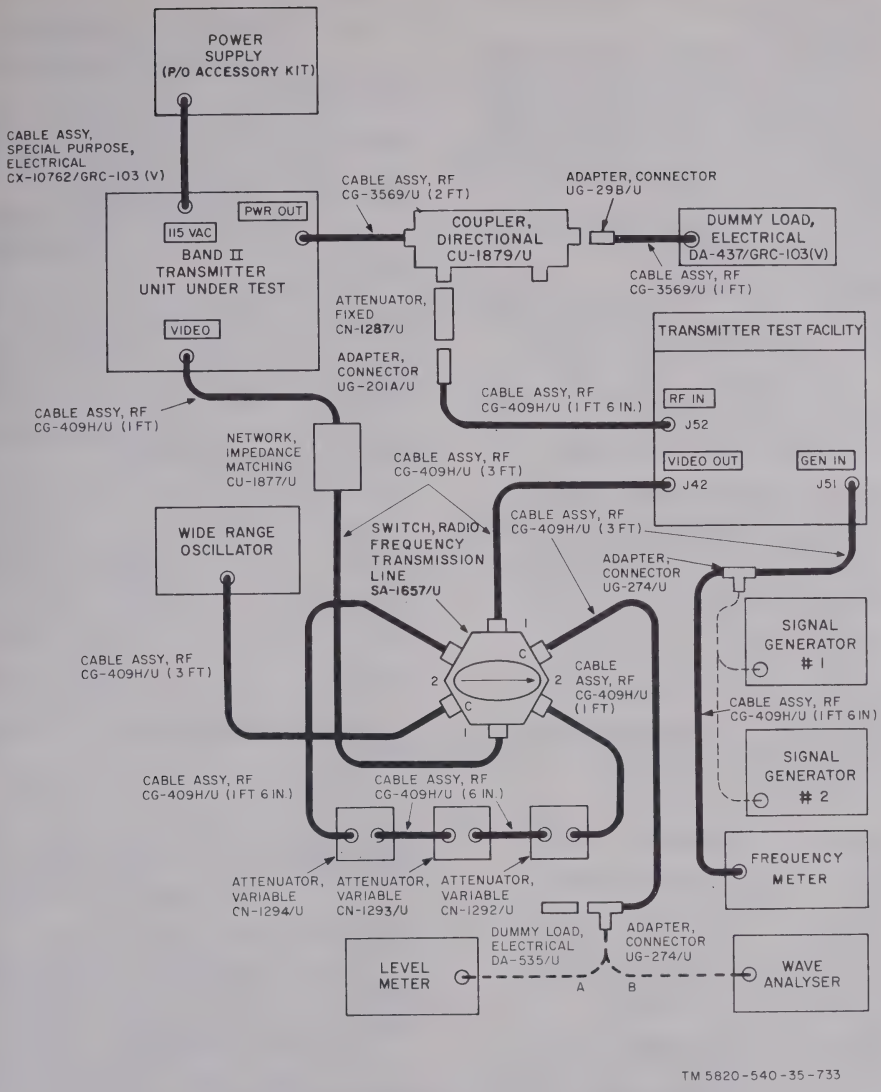


Figure 4-296. Band II transmitter frequency response and spurious interference check, test setup.

3. Set the coaxial switch to position 1.

4. Tune the wide range oscillator to 10 kHz and set the signal generator to 400 MHz at 0 dbm.

5. Set the frequency of the level meter to 10 kHz.

6. On the unit under test, set the meter selector switch to the 12 CHAN PCM position and adjust the INPUT control for a 50 percent of full scale indication on the unit under test meter.

7. Record the output signal indicated on the level meter. This is the reference level.

8. Disconnect the wide range oscillator and search for spurious signals with the level meter from 10 kHz up to 1 MHz. Note the amplitude of the spurious outputs. They should be at least 60 db below the reference.

9. Replace the level meter with the wave analyzer (B, fig. 4–296).

10. Set up the reference level using a 10-kHz signal as described in *3* through *7* above.

11. Disconnect the wide range oscillator and search for spurious signals with the wave analyzer from 200 Hz up to 10 kHz. Note the amplitude of the spurious outputs. They should all be at least 50 db below reference.

12. Repeat *2* through *11* above at test channels 430, 759, 760 and 990.

(8) *Power consumption check.*

(*a*) Set the voltage control on the power supply (part of the accessory kit) to 115v ac.

(*b*) Tune the unit under test to any channel as described in (1)(*g*) and (*h*) above and note the indication on the power supply ammeter. Indication should be 3.2 amp ± 10 percent.

4–138. Receiver Radio R–1329(P)/GRC–103(V) and Amplifier-Converter AM–4317/GRC–103(V) (Receiver Fixed and RF Heads) Tests and Alignment

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Test Facility Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Voltmeter Electronic ME–30A/U.	VTVM
Generator, Signal AN/USM–205.	Wide range oscillator
Generator, Signal SG–409( )/U.	Signal generator No. 1
Generator, Signal SG–340A/G.	Signal generator No. 2
Selective Voltmeter AN/USM–306.	Level meter
Frequency Meter AN/USM–159.	Frequency meter
Generator, Thermal Noise SG–419/U.	Noise generator
Wave Analyzer, Bruel and Kjoer 2107.	Wave analyzer
Mixer SM–D–696046	
Adapter-Connector UG–636A/U.	
Adapter-Connector UG–107B/U.	
Cable Assembly, Special Purpose Electrical CMC 217–800009.	
Cable Assembly, Special Purpose Electrical CX–10762/GRC–103(V).	

b. Test Procedures.

(1) *Preliminary operational checks.*

(*a*) Connect the test equipment as shown in A, figure 4–297.

(*b*) Set the voltage control on the power supply (part of the accessory kit) to 115v ac.

(*c*) Set the unit under test AC POWER switch to ON. Observe the following:

1. The AC POWER lamp should light.

2. The LOW SIGNAL alarm lamp should light.

3. If the SYNC alarm lamp lights, it should go out again within 10 seconds.

4. The buzzer may sound; press the BUZZER OFF button to silence the buzzer.

(*d*) On the unit under test, set the meter selector switch to the following positions and observe the meter indications:

Switch position	Typical indication
+12V DC	Within the green band
−12V DC	Within the green band
OSC	20% to 90% of full scale
DOUBLER	20% to 90% of full scale
MULT	0 to 10% of full scale (off tune).
RCVR SIG	Less than 40% of full scale

(*e*) Set the unit under test controls as follows:

Control	Position
RCVR CHANNEL	Channel 560
RCVR SIG	Channel 560
XMTR DUPL	At least 50 channels away from RCVR SIG channel.
Meter selector switch	MULT

(*f*) Tune the MULT PEAK control for maximum indication on the meter. The VTVM should indicate approximately —9 dbm.

(*g*) Set the meter selector switch to RCVR SIG; the meter should indicate less than 40 percent of full scale.

(*h*) Set signal generator No. 2 to 480 MHz at an output of —64 dbm (—74 dbm at the ANT. connector of the unit under test). The LOW SIGNAL alarm lamp should go out and the buzzer should sound. Silence the buzzer.

(*i*) Adjust the unit under test RCVR SIG control for a maximum indication on the meter. (Tune the RCVR SIG control for a ten percent drop on either side of maximum, then set the RCVR SIG control midway between these two points.)

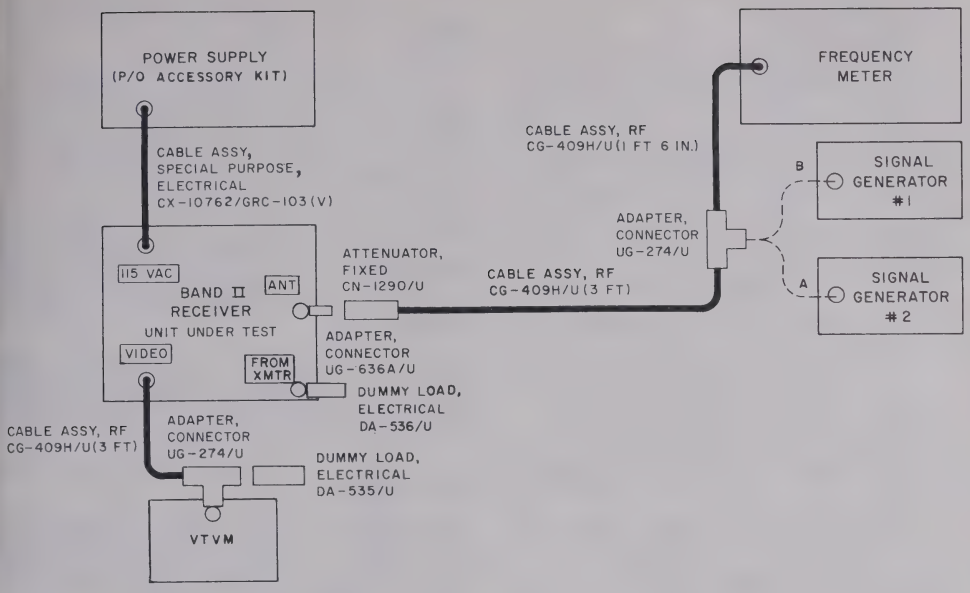


Figure 4-297. Receiver receive signal adjustment and spurious interference check, test setup.

(*j*) Observe the VTVM indication; it hould be approximately —46 dbm or less.

NOTE

The minimum VTVM indication and maximum RCVR SIG meter indication should occur simultaneously (at the same RCVR SIG setting).

(*k*) Set the AC POWER switch to OFF.

(*l*) Not used.

(*m*) Remove radio receiver 1RE1 from the eceiver case and use extension cables CX-12056/U (1 ft 3 in.) and CX-12057/U (1 ft) o restore connections. Set the AC POWER switch o ON and check the meter indications.

Meter selector switch position	Typical indication
+12V DC	Within the green band
-12V DC	Within the green band
OSC	20% to 90% of full scale
DOUBLER	20% to 90% of full scale
MULT	20% to 90% of full scale
RCVR SIG	Above 40% of full scale

(2) *Received signal monitoring.*

NOTE

This adjustment is a continuation of the preliminary operational checks above.

(*a*) Adjust the signal generator output to —40 dbm (—50 dbm input at the ANT. connector of the unit under test).

(*b*) Locate the RCVR SIG ADJUSTMENT control (on the right-hand side of the extended radio receiver 1RE1) and set it fully clockwise.

(*c*) Locate the METER RCVR SIG control of the video amplifier 1RE1AR1 (fig. 3-32) and adjust it for a 60 percent of full scale indication on the meter (meter selector switch in the RCVR SIG position).

(*d*) Reduce the level of signal generator No. 2 to —115 dbm. RCVR SIG meter indication should be below 40 percent. The LOW SIGNAL

alarm lamp should light and the buzzer should sound. Silence the buzzer.

(*e*) Increase the output level of signal generator No. 2 to —85 dbm. The RCVR SIG meter indication should increase by more than 10 percent. The LOW SIGNAL alarm should go out and the buzzer should sound. Silence the buzzer.

(*f*) If these conditions are not met proceed as follows:

1. Adjust signal generator No. 2 output level to —40 dbm.

2. Turn the RCVR SIG ADJUSTMENT counterclockwise until the meter indicates 50 percent of full scale.

3. Readjust the METER RCVR SIG control on video amplifier 1RE1AR1 for 60 percent of full scale indication on the meter.

4. Repeat the tests described in (*d*) and (*e*) above. If necessary, repeat the adjustment procedure above.

(*g*) Repeat the receive signal monitoring checks ((*a*) through (*e*) above) for the channels shown below. Tune for maximum RCVR SIG indications with the appropriate signal generator output level at —64 dbm.

Test channel	RCVR CHANNEL and RCVR SIG setting	XMTR DUPL setting	Signal generator frequency (MHz)
*400	400	1000	400
*500	500	1000	450
600	600	1000	500
700	700	1000	550
800	800	400	600
900	900	400	650
1000	1000	400	700

*Use signal generator No. 1 (B. fig. 4–297).

(3) *Demodulation sensitivity check.*

(*a*) Connect the test equipment as shown in A, figure 4–298.

(*b*) Set signal generator No. 1 frequency to 450 MHz as indicated on the frequency meter.

(*c*) Set the unit under test controls as follows:

Control	Position
RCVR CHANNEL	Channel 500
RCVR SIG	Channel 500
XMTR DUPL	At least 100 channels away from the RCVR SIG channel.
AC POWER	ON
MULT PEAK	Tune for maximum meter indication.

(*d*) Set the test facility switches as follows:

Switch	Position
S1	ON
S9	30 MHZ LEVEL
S14	30 MHZ
AT1	0 DB

(*e*) Adjust signal generator No. 1 output level to obtain a 5.0 mv indication on the VTVM.

(*f*) Set the facility switch S9 to 300 KHZ DEVIATION.

(*g*) Set the unit under test meter selector switch to 24 CH PCM; the meter should indicate within the green band. The VTVM should indicate 0.159v ± 0.018v rms (—13.7 dbm ± 1 db).

(*h*) Set test facility switch S9 to 180 KHZ DEVIATION.

(*i*) Set the unit under test meter selector switch to 12 CH PCM; the meter should indicate within the green band. The VTVM should indicate 0159v ± 0.018v rms (—13.7 dbm ± 1 db).

(*j*) On the unit under test, remove the 91-ohm load from the PCM output connector. The meter indication should drop to zero.

(*k*) On the unit under test replace the 91-ohm load at the PCM output connector. The meter should indicate within the green band.

(*l*) Not used.

(*m*) Connect the test equipment as shown in B, figure 4–298.

(*n*) Set the test facility switch S9 to 75 KHZ DEVIATION.

(*o*) Set the unit under test meter selector switch to FDM; the meter should indicate within the green band. The VTVM should indicate 0.189v ± 0.021v rms.

(*p*) Connect the test equipment as shown in C, figure 4–298.

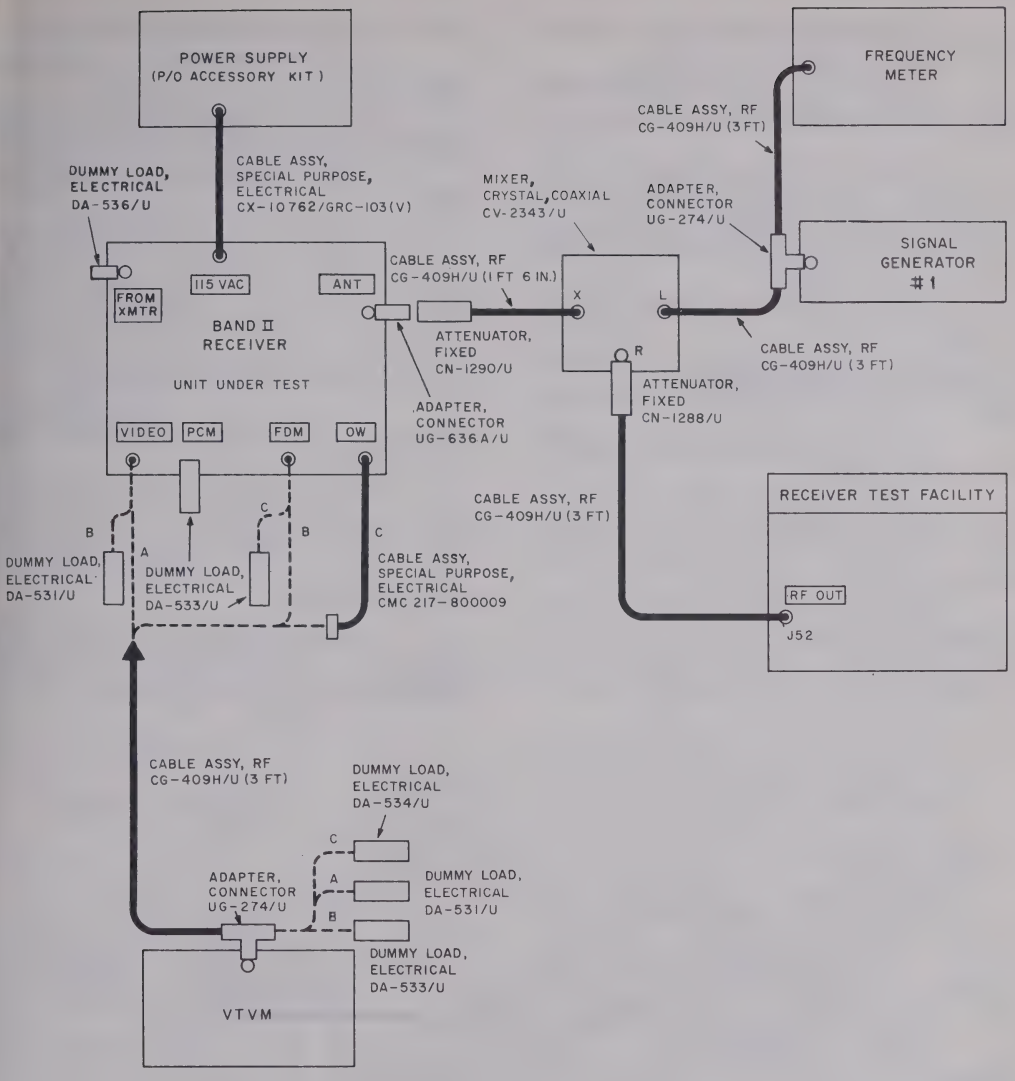
(*q*) Set the test facility switch S9 to 45 KHZ DEVIATION.

(*r*) Set the unit under test meter selector switch to OW; the meter should indicate within the green band. The VTVM should indicate 0.245v ± 0.045v rms (—10 dbm ± 2 db).

(4) *Video gain stability measurement.*

(*a*) *Initial calibration procedure.*

1. Connect the test equipment as shown in A, figure 4–299.



TM580-540-35-739

Figure 4-298. Band II receiver demodulation sensitivity check, test setup.

2. Set signal generator No. 1 frequency to 460 MHz at a level of —85 dbm (—95 dbm signal at the ANT. connector).

3. Set the unit under test controls as follows:

Control	Position
RCVR CHANNEL	Channel 520
RCVR SIG	Channel 520
XMTR DUPL	At least 100 channels away from the RCVR SIG setting.
AC POWER	ON
MULT PEAK	Tune for maximum meter indication.

4. On the unit under test, set the meter selector switch to RCVR SIG and adjust the fre-

quency of signal generator No. 1 for a maximum indication on the unit under test meter.

5. Set the level meter frequency to 400 kHz at 2.0 kHz bandwidth. Record the level meter indication.

6. Repeat *1* through *5* above for signal generator No. 1 output levels of —74 dbm, —54 dbm, and —44 dbm. (—84 dbm, —64 dbm, and —54 dbm inputs at the ANT. connector.) Record each level meter indication.

7. Connect the test equipment as shown in B, figure 4–299.

8. Set signal generator No. 1 frequency to 430 MHz ± 30 kHz as shown on the frequency meter.

9. Set test facility switches S1 to ON and S9 to 30 MHZ LEVEL.

10. Adjust signal generator No. 1 output level to obtain an identical level meter indication as in *5* above. Record signal generator No. 1 attenuator setting.

11. Repeat *10* above to obtain identical level meter indications as in *6* above for each signal generator No. 1 level used. Record each of the signal generator No. 1 attenuator settings.

(b) Video gain stability vs output level.

1. Use the test setup shown in B, figure 4–299.

2. Return signal generator No. 1 attenuator setting to that recorded in *(a)10* above.

3. Set the test facility switches as follows:

Switch	Position
S9	EXT. VIDEO
S14	30 MHZ
AT1	0 DB

4. Set the level meter to 10 kHz.

5. Set the wide range oscillator to 10 kHz and adjust the output level for a —5 dbm indication on the level meter.

6. Return signal generator No. 1 attenuator to each of the settings recorded in *(a)11* above. The level meter indication should remain within —5 dbm ± 0.5 db for each of the above attenuator settings.

7. Return signal generator No. 1 attenuator to the setting recorded in *(a)10* above. The level meter indication should return to —5 dbm.

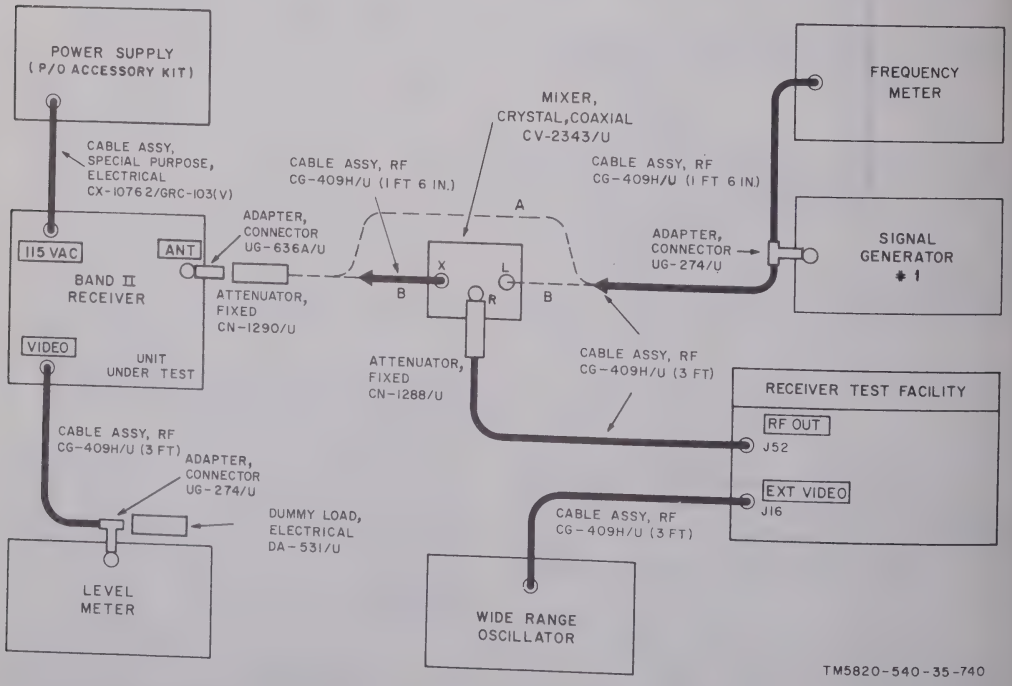


Figure 4–299. Band II receiver video gain stability check, test setup.

(c) *Video gain stability vs supply voltage variation.*

1. With the equipment set as in (b)7 above, vary the voltage control on the power supply (part of the accessory kit) between 105 volts and 125 volts ac. The level meter indication should remain within —5 dbm ± 0.5 db.

2. Set the voltage control on the power supply to 115 volts ac.

3. Disconnect the power supply from the 60-Hz source and connect it to a 400-Hz source. The level meter indication should remain within —5 dbm ± 0.5 db.

4. Reconnect the power supply to the 60-Hz source.

(5) *Video frequency response.*

(a) *Initial calibration procedure.*

1. Connect the test equipment as shown in A, figure 4–300.

2. Set the unit under test controls as follows:

Control	Position
RCVR CHANNEL	Channel 390
RCVR SIG	Channel 390
XMTR DUPL	At least 60 channels away from RCVR SIG channel.
AC POWER	ON

3. Set signal generator No. 1 frequency to 365 MHz ± 30 kHz as shown on the frequency meter.

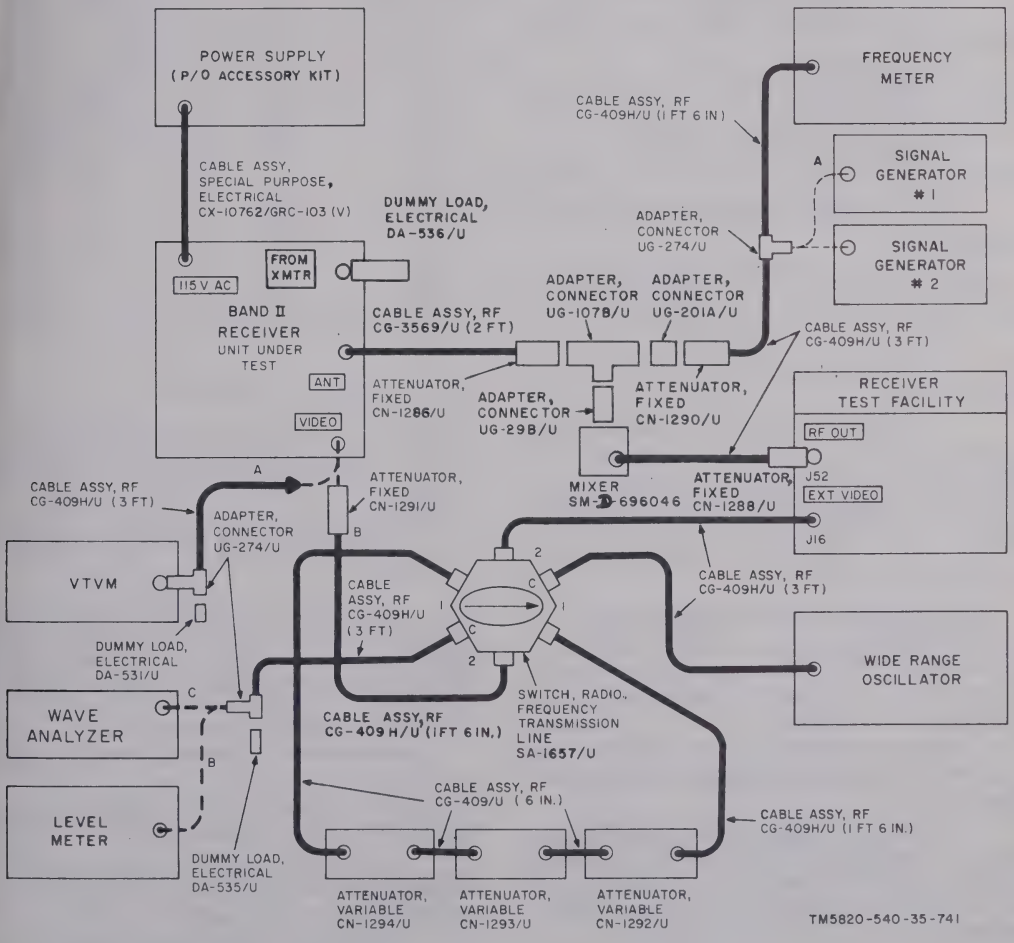


Figure 4–300. Band II receiver video frequency response check, test setup.

4. Set the test facility switches as follows:

Switch	Position
S1	ON
S9	30 MHZ LEVEL
S14	30 MHZ
AT1	0 DB

5. Adjust signal generator No. 1 attenuator for a 5 mv indication on the VTVM.

6. Set the unit under test meter selector switch to RCVR SIG and tune the RCVR SIG control for a maximum meter indication.

7. Connect the test equipment as shown in B, figure 4–300.

8. Set the coaxial switch to position 2.

9. Set test facility switch S9 to 75 KHZ DEVIATION.

10. Set the unit under test meter selector switch to FDM; the mter should indicate within the green band. Note the meter indication.

11. Set test facility switch S9 to EXT VIDEO.

12. Check the signal-to-noise ratio as decribed below.

(a) Set the wide range oscillator to 400 kHz and adjust the output level until the unit under test meter indicates as in *10* above.

(b) Set the level meter to 400 kHz with 2.0-kHz bandwidth and record the level meter indication.

(c) Disconnect the wide range oscillator from the coaxial switch and record the level meter indication. The difference between this reading and the one recorded in (b) above should be greater than 20 db.

(d) Reconnect the wide range oscillator to the coaxial switch.

(*b*) *Frequency response measurement.*

1. With the coaxial switch in position 2, set the wide range oscillator to 10 kHz and adjust the output level until the unit under test meter indicates as in (*a*)*10* above.

2. Set the level meter to 10 kHz and the bandwidth to 2.0 kHz. Record the level meter indication.

3. Set the coaxial switch to position 1. Adjust the variable attenuators for the same level meter indication as in *2* above ± 0.1 db. Record the variable attenuator settings; this is the reference level.

4. Repeat *1* through *3* above for all frequencies listed in the chart below and record th attenuation with respect to the reference lev obtained in *3* above.

NOTE

For frequencies below 10 kHz, replace the level meter with the wave analyzer (C, fig. 4–300).

Wide range oscillator and level meter frequency (kHz)	Relative attenuation (db), reference 10 kHz		
	Nominal	Minimum	Maximum
0.125	1.0	0	2.5
0.200	0.5	0.2	1.0
0.250	0.2	−0.2	0.4
1.0	0	−0.1	0.1
10	Reference		
30	0	−0.1	0.1
60	0.15	0.05	0.25
120	0.6	0.2	0.9
180	1.3	0.8	1.8
240	2.3	1.8	2.8
360	5.1	4.4	5.8
480	9.0	8.2	10.0
600	14.0	12.5	15.5
720	20.2	18.4	22.6
840	27.5	25.3	31.0
960	36.0	33.0	40.0

NOTE

Check to see that the attenuation at 360 kHz does not change by more than ± 1 db when the XMTR DUPL control is tuned across its range, except within ± 32 channels of the RCVR CHANNEL setting.

5. Set the RCVR CHANNEL an RCVR SIG controls to 1000 and the XMTR DUPL control to 900 and repeat steps *1* through *4* abov (signal generator No. 2 frequency of 670 MHz).

(6) *Noise figure measurement.*

(*a*) Connect the test equipment as show in A, figure 4–301.

(*b*) Set noise generator switch 10–20 to 1 and its output level control to OFF.

(*c*) Set signal generator No. 1 frequency t 400 MHz and its output level to —54 dbm (—7 dbm at the ANT. connector).

(*d*) Set the unit under test controls as fol lows:

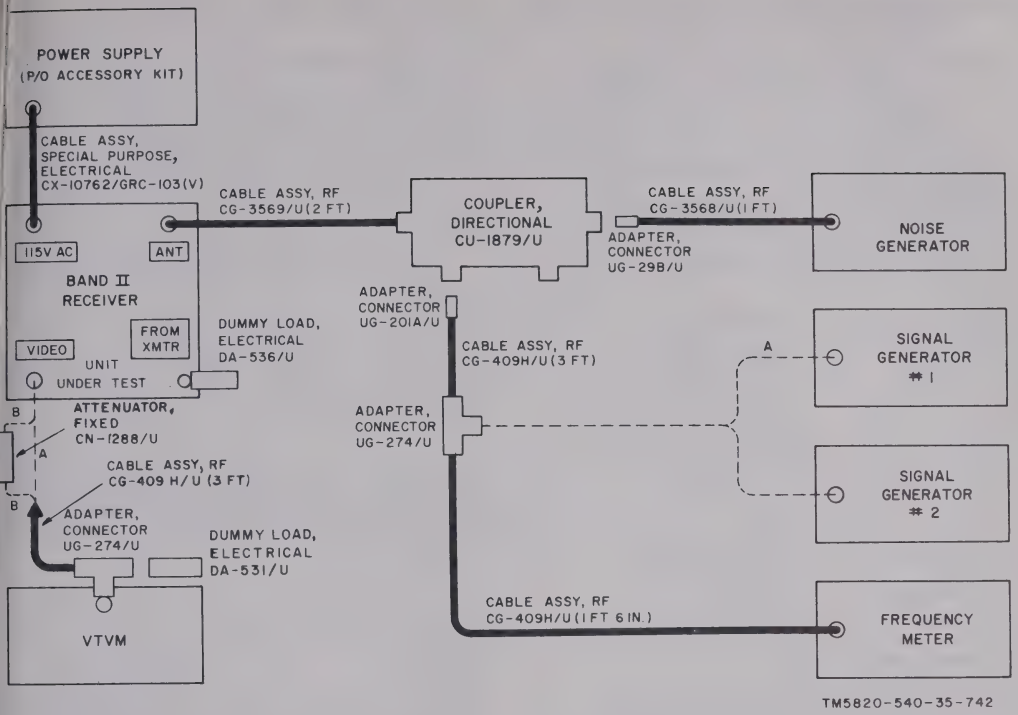


Figure 4-301. Band II receiver noise figure measurement, test setup.

Control	Position
CVR CHANNEL	Channel 400
CVR SIG	Channel 400
MTR DUPL	At least 100 channels away from RCVR SIG setting.
C POWER	ON
leter selector switch	MULT

(*e*) Tune the MULT PEAK control for naximum meter indication. Set the meter selector witch to RCVR SIG and tune the RCVR SIG ontrol for a maximum meter reading. The noise evel as indicated on the VTVM should be approximately 46.0 dbm. Note the VTVM indication.

(*f*) Insert a 3-db attenuator between the VIDEO connector and the VTVM (B, fig. 4-301). -301).

(*g*) Adjust the output level control on the oise generator to obtain the same VTVM indication as in (*e*) above. Allow 10 seconds for conditions to stabilize, then read the noise figure on the oise generator meter; it should not exceed 8 db. Return the output level control to OFF after each reading.

(*h*) Repeat (*e*) through (*g*) above using signal generator No. 2 for the test channels listed in the chart below keeping the XMTR DUPL setting at least 100 channels away from the RCVR SIG setting.

RCVR and RCVR CHANNEL setting	Signal generator No. 2 frequency (MHz)
600	500
800	600
1000	700

(7) *Power consumption check.*

(*a*) Connect the equipment to the power supply (part of the accessory kit).

(*b*) Set the voltage control on the power supply to 115v ac.

(*c*) Set the unit under test AC POWER switch to ON and note the indication on the power supply ammeter; it should be 0.45 ampere.

4–139. Radio Set AN/GRC–103(V)2 (Band II) System Tests and Alignment

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2896(V)1/GRM–95(V).	Transmitter test facility
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory
Voltmeter, Electronic ME–20A/U.	VTVM
Generator, Signal AN/USM–205.	Wide range oscillator
Generator, Signal SG–409( )/U.	Signal generator No. 1
Generator, Signal SG–340A/G.	Signal generator No. 2
Selective Voltmeter AN/USM–306.	Level meter
Wattmeter AN/URM–120	Wattmeter
Frequency Meter AN/USM–159.	Frequency meter
Mixer SM–D–696046	Mixer
Adapter-Connector UG–636A/U.	
Cable Assembly, Special Purpose Electrical Branched CMC 217–800011.	
Cable Assembly, Special Purpose, Electrical Branched CMC 217–800012.	
Cable Assembly, Special Purpose, Electrical Branched CX–10763/GRC–103(V).	
Distortion Analyzer TS–1344/U.	Distortion analyzer
Oscilloscope AN/USM–281	Oscilloscope
Wave Analyzer Bruel and Kjoer 2107.	Wave analyzer
Cable Assembly, RF CG–3444/U (1 ft 6 in.).	
Cable Assembly, Special Purpose, Electrical CX–10762/GRC–103(V) (2 required).	

b. Test Procedures.

(1) *Transmitter antenna power check.*

(*a*) Connect the test equipment as shown in figure 4–302.

(*b*) Set the receiver and transmitter AC POWER switches to their ON and ON/RESET position.

(*c*) Set the voltage control on the accessory kit power supply to 115v ac ± 2v as indicated on the VOLTS meter. Keep the voltage within the above limits during the tests. The ammeter on the power supply should indicate less than 4.1 amperes.

(*d*) Observe the following on the uni under test:

1. AC POWER lamps should light.

2. SYNC alarm lamps may light; the should extinguish within 10 seconds.

3. LOW POWER alarm lamp shoul light.

4. LOW SIGNAL alarm should light.

5. Buzzers should sound; silence th buzzers.

6. Blower should operate.

(*e*) On the receiver, set the RCV CHANNEL and RCVR SIG controls to channe 1000 and the XMTR DUPL control to channe 400.

(*f*) On the transmitter. set the XMT CHANNEL and XMTR TUNE controls t channel 400. Set the meter selector switch to th following positions in turn and observe the mete indication.

Meter selector switch position	Typical meter indication
12V DC	Within green band
28V DC	Within green band
600V DC	Within green band
OSC	20% to 90% full scale
DOUBLER	20% to 90% full scale
MULT	20% to 90% full scale
DRIVER	20% to 90% full scale*

*May not be 20% to 90% until after unit is fully tuned.

(*g*) Set the transmitter meter selecto switch to PWR OUT and adjust the XMT TUNE and PWR OUT PEAK controls for max mum indication. The meter should indicate n less than 40 percent of full scale. The LO POWER alarm light should go out and the buzze should sound; silence the buzzer.

(*h*) Set the transmitter meter selecto switch to REFL PWR and tune the receive XMTR DUPL control for minimum indication o the transmitter meter; the meter should indicat less than 15 percent of full scale.

(*i*) Set the receiver meter selector switc to XMTR DUPL. Readjust the XMTR DUP control on the receiver for maximum indicatio on the receiver meter, keeping the XMT CHANNEL indication within 0.5 inch of th center of the display window. The receiver mete should indicate not less than 40 percent of fu scale.

(*j*) Set the receiver meter selector switc to REFL PWR; the receiver meter should indi

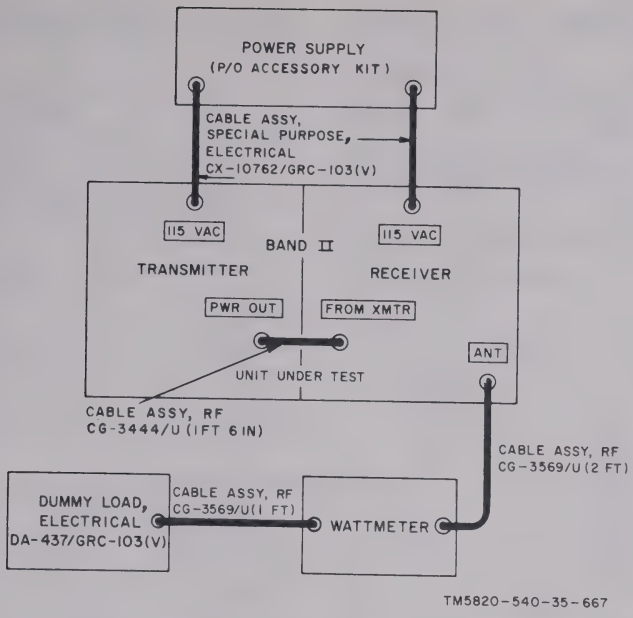


Figure 4–302. Band II radio set output power to antenna, test setup.

cate less than 15 percent of full scale and the wattmeter should indicate not less than 15 watts.

(*k*) Repeat steps (*e*) through (*j*) above for the channels listed below:

NOTE

Omit the 12V DC, 28V DC and 600 V DC metering checks in (*f*) above.

NOTE

Set the transmitter AC POWER switch to OFF when changing from receiver channel 1000 to 400.

XMTR CHANNEL XMTR TUNE and XMTR DUPL channel settings	RCVR CHANNEL and RCVR SIG channel settings
400	1000
500	1000
600	1000
700	400
800	400
900	400
1000	400

(*l*) Not used.

(*m*) Set the transmitter AC POWER switch to OFF.

(2) *System gain and frequency response measurement.*

(*a*) *Initial calibration.*

1. Connect the test equipment as shown in A, figure 4–303.

2. Set signal generator No 2 frequency to 520 MHz as indicated on the frequency meter and set the output attenuator to —94 dbm.

3. Set the coaxial switch to position 1.

4. Set the receiver controls as follows:

Control	Setting
RCVR CHANNEL	Channel 640
RCVR SIG	Channel 640
XMTR DUPL	Channel 740
AC POWER	ON
Meter selector switch	MULT
MULT PEAK	Tune for maximum meter indication.
Meter selector switch	RCVR SIG
RCVR SIG	Tune for maximum meter indication.

5. Set the level meter to 400 kHz and 2.0 kHz bandwidth. Record the level meter indication.

6. Record the level meter indications for signal generator output levels of —84 dbm, —74 dbm, —64 dbm, and —54 dbm. The level meter indications should decrease in approximately 10-db steps.

NOTE

Agc action may be noticed before reaching the —54 dbm level.

7. Connect the test equipment as shown

in B, figure 4-303 with coaxial switch in position 1.

8. Disconnect the wide range oscillator.

9. Set the AC POWER switch on the transmitter to ON/RESET.

10. Set the transmitter to channel 740 and tune for maximum PWR OUT as described in (1) (*f*) through (*j*) above.

11. Set signal generator No. 1 frequency to 50 MHz and adjust the output level until the level meter indication is the same as obtained in above for —74 dbm.

NOTE

Use this signal generator output level throughout the following system gain and frequency response measurement in (*b*) and (*c*) below.

12. Reconnect the wide range oscillator

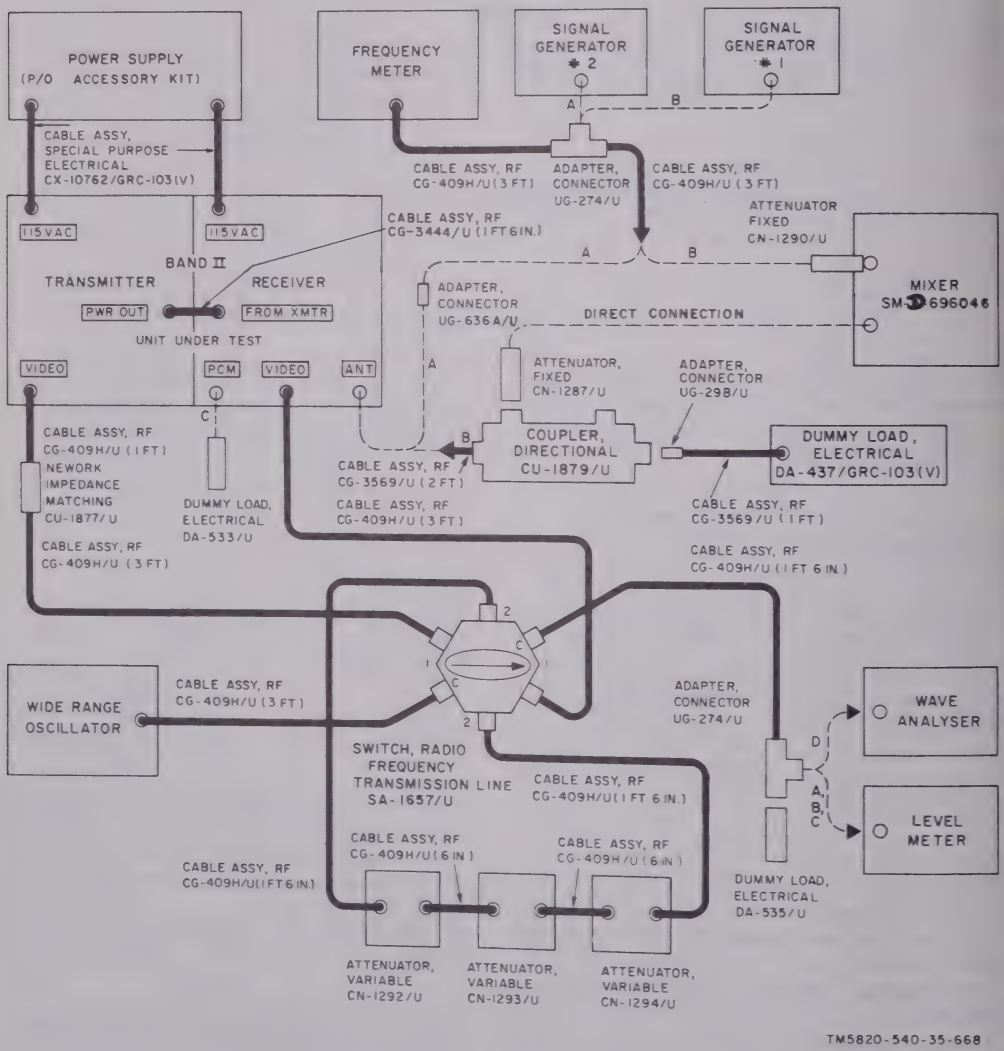


Figure 4-303. Band II radio set, system gain and frequency response measurements, test setup.

(*b*) *System gain measurement.*

1. Connect the test equipment as shown B, figure 4–303.

2. Set the coaxial switch to position 1.

3. Set the transmitter and receiver meter lector switches to their respective 24 CH PCM ositions.

4. Set the transmitter INPUT control to idrange.

5. Set the wide range oscillator to 10 Hz and adjust the output level for a 50 percent ndication on the transmitter meter. The receiver neter should indicate between 40 and 65 percent f full scale.

6. Set the level meter to 10 kHz and 2.0 kHz bandwidth. The level meter should indicate —0.3 dbm ± 3 db.

7. Set transmitter and receiver meter selector switches to their 12 CH PCM positions.

8. Terminate the PCM connector on the unit under test with a 91-ohm load (C, fig. 4–303).

9. Repeat *4* through *6* above. The level meter should indicate —4.8 dbm ± 3 db and the receiver meter should indicate within the green band.

(*c*) *Frequency response measurement.*

1. Connect the test equipment as shown in B, figure 4–303.

2. Set the coaxial switch to position 1.

3. Set the transmitter and receiver meter selector switch to their FDM positions. Set the INPUT control to midrange.

4. Set the wide range oscillator to 10 kHz and adjust the output level control for a 65 percent full scale indication on the transmitter meter.

5. Set the wide range oscillator to 960 kHz, and set the level meter to 960 kHz and 2.0 kHz bandwidth. Record the level meter indication.

6. Temporarily disconnect the wide range oscillator and note the level meter indication. It should be at least 20 db below the level recorded in *5* above. Reconnect the wide range oscillator.

7. Set the wide range oscillator to 10 kHz. Record the output level of the wide range oscillator as indicated on its own meter, and maintain this level throughout the remaining steps.

8. Set the level meter to 10 kHz and 2.0 kHz bandwidth. Record the level meter indication.

9. Set the coaxial switch to position 2. Adjust the variable attenuators to obtain the same level meter indication as in *8* above. Record the variable attenuators setting; this is the 10-kHz reference level.

10. Repeat steps *7*, *8* and *9* above for all modulating frequencies above 10 kHz listed in the chart below. The relative attenuation should be within the corresponding limits shown.

11. Replace the level meter with the wave analyzer as shown in D, figure 4–303.

Modulating frequency (kHz)	Relative attenuation (db), reference attenuation 10 kHz		
	Nominal	Minimum	Maximum
0.125	2.0	1.0	3
0.200	1.0	0	2
0.250	0.4	0	0.8
0.5	0	−0.1	0.1
1.0	0	−0.1	0.1
10	REF	REF	REF
30	0	−0.1	0.2
60	0.2	0.1	0.4
120	0.7	0.5	1.0
180	1.6	1.3	2.2
240	2.9	2.5	4.0
360	6.5	5.7	8.0
480	11.7	10.2	13.5
600	18.2	16.0	21.0
720	26.2	23.1	30.5
840	35.7	31.7	41.0
960	46.7	41.2	52.5

12. Set the wave analyzer switches as follows:

Switch	Position
INPUT	DIRECT
METER	RMS, FAST
METER RANGE	as required
RANGE MULTIPLIER	−20 DB
FUNCTION SELECTOR	FREQUENCY ANALYSIS
WEIGHTING NETWORK	LINEAR 2 to 40,000

13. Repeat steps *8* and *9* above for all modulating frequencies below 10 kHz listed in table above. The relative attenuation should be within the corresponding limits shown.

(3) *Signal-to-noise and high signal protection circuits check.*

(*a*) *Deviation calibration procedure.*

1. Connect the test equipment as in figure 4–304.

2. Set signal generator No. 2 frequency to 520 MHz as indicated on the frequency meter and set the output level to —74 dbm.

3. Set the receiver controls as follows:

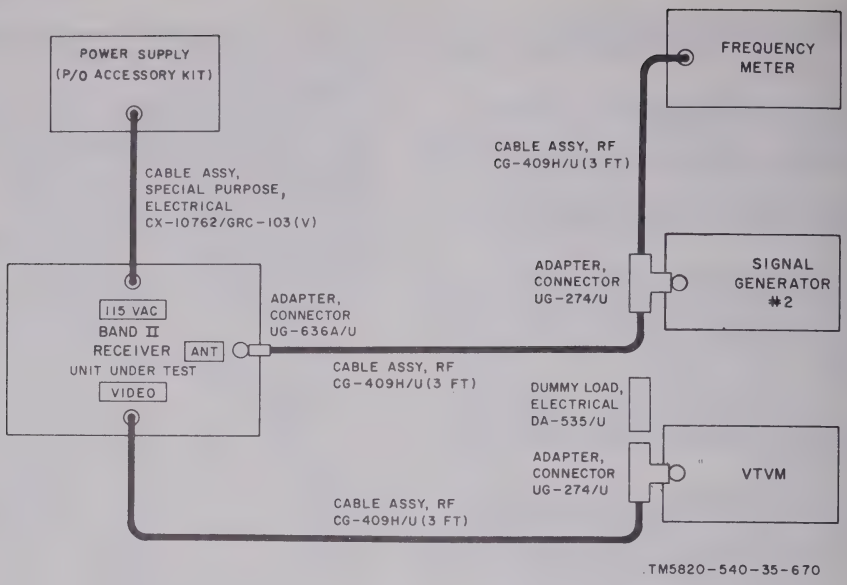


Figure 4-304. Band II receiver deviation calibration procedure, test setup.

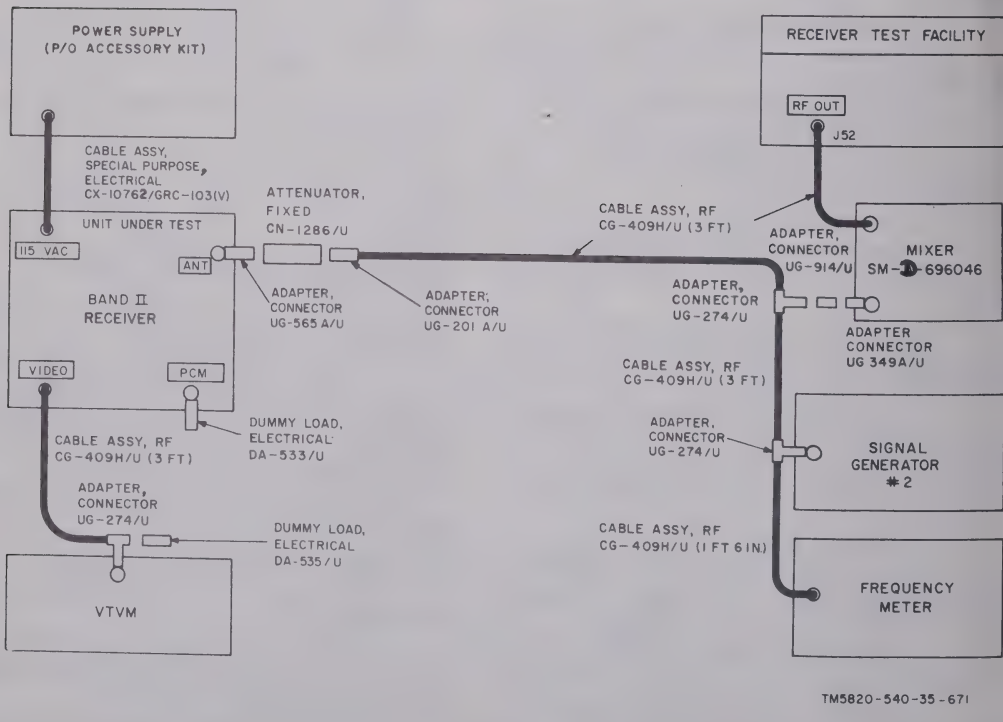


Figure 4-305. Band II receiver deviation measurement, test setup.

Controls	Settings
CVR CHANNEL	Channel 640
CVR SIG	Channel 640
MTR DUPL	Channel 740
C POWER	ON
Meter selector switch	MULT
MULT PEAK	Tune for maximum meter indication.
Meter selector switch	RCVR SIG
RCVR SIG	Tune for maximum meter indication.

4. Record the noise level as indicated on the VTVM.

5. Set the signal generator output level to —94 dbm and record the VTVM indication (noise level).

6. Connect the test equipment as shown in figure 4–305.

7. Set signal generator No. 2 to 550 MHz as indicated on the frequency meter.

8. Set the test facility switches as follows:

Switch	Position
S1	ON
S9	30 MHZ LEVEL
S14	30 MHZ
AT1	0 DB

NOTE

Check for maximum RCVR SIG meter indication on the receiver meter.

9. Adjust the signal generator output level to obtain the same VTVM indication (noise level) as in *4* above.

10. Set test facility switch S9 to 180 KHZ DEVIATION.

11. Set the receiver meter selector switch to 12 CH PCM. The receiver meter should indicate within the green band; record this indication. The VTVM should indicate 159 mv ± 18 mv (—13.5 dbm ± 1 db); record this indication.

12. Set test facility switch S9 to 300 KHZ DEVIATION.

13. Set the receiver meter selector switch to 24 CH PCM. The receiver meter should indicate within the green band; record this indication. The VTVM should indicate 265 mv ± 30 mv; record this indication.

14. Adjust the signal generator output for a VTVM indication (noise level) as obtained in *5* above and repeat *10* through *13*. The VTVM should indicate as in *11* and *13* above.

(*b*) *Signal-to-noise measurement.*

1. Connect the test equipment as shown in figure 4–306.

2. Set signal generator No. 1 frequency to 50 MHz as indicated on the frequency meter.

3. Set the receiver controls as follows:

Controls	Settings
RCVR CHANNEL	Channel 640
RCVR SIG	Channel 640
XMTR DUPL	Channel 740
AC POWER	ON
Meter selector switch	MULT
MULT PEAK	Tune for maximum meter indication.
Meter selector switch	RCVR SIG
RCVR SIG	Tune for maximum meter indication.

4. Disconnect the wide range oscillator.

5. Switch on the transmitter, set it to channel 740, and tune for maximum PWR OUT and minimum REFL PWR indications as described in (1) (*g*) through (*i*) above.

6. Adjust the signal generator output level for a VTVM noise level indication as obtained in (*a*)*4* above.

7. Set the receiver and transmitter meter selector switches to their 12 CH PCM positions. Set the transmitter INPUT control to midrange.

8. Reconnect the wide range oscillator.

9. Set the wide range oscillator to 10 kHz and adjust its output to obtain a 50 percent indication on the transmitter meter. The receiver meter should indicate as in (*a*)*11* above. The VTVM should indicate 159 mv ± 18 mv (—13.5 dbm ± 1 db); note this indication.

10. Disconnect the wide range oscillator and record the noise level on the VTVM. It should be at least 31.25 db below the level noted in *9* above.

11. Adjust the signal generator output level to obtain the same VTVM noise level as in (*a*)*5* above.

12. Reconnect the wide range oscillator. The receiver meter should indicate as in (*a*)*13* above. The VTVM should indicate 159 mv ± 18 mv (—13.5 dbm ± 1 db); note this indication.

13. Disconnect the wide range oscillator and record the noise level as indicated on the VTVM; it should be at least 11.25 db lower than the level noted in *12* above.

14. Set the transmitter and receiver meter selector switches to their 24 CH PCM positions.

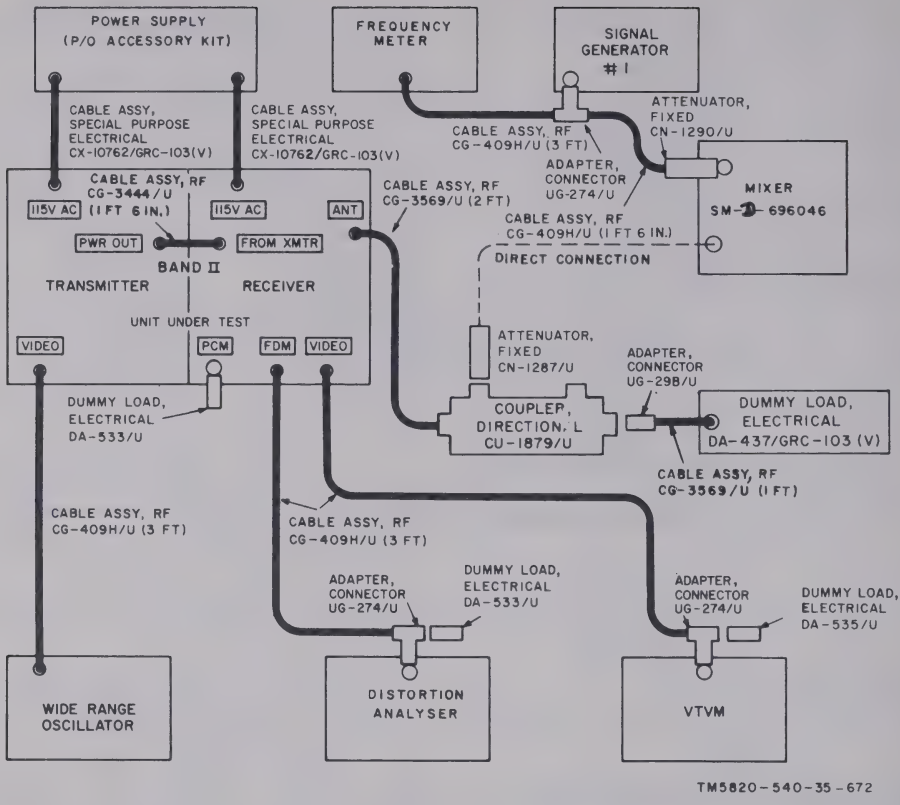


Figure 4-306. Band II radio set signal-to-noise and harmonic distortion measurement, test setup.

NOTE

The equipment is set up for a —94 dbm signal level from the previous test.

15. Reconnect the wide range oscillator and adjust the output level to obtain a 50 percent indication on the transmitter meter. The VTVM should indicate 265 mv ± 30 mv; note this indication.

16. Disconnect the wide range oscillator and record the noise level on the VTVM. It should be at least 15.25 db below the level noted in *15* above.

17. Adjust the signal generator to obtain the same VTVM indication as recorded in (*a*)*4* above.

18. Reconnect the wide range oscillator and adjust its output level to obtain 50 percent of full scale indication on the transmitter meter. The VTVM should indicate 265 mv ± 30 mv; record this indication.

19. Disconnect the wide range oscillator and record the noise level on the VTVM. It should be at least 35.25 db below the level recorded in *18* above.

(*c*) *High signal alarm and receiver protection check.*

NOTE

This is a continuation of the test in (*b*) above.

1. Tune the receiver RCVR SIG control to channel 740. The HIGH SIGNAL alarm lamp should light and the buzzer should sound; silence the buzzer.

2. Leave the equipment in this condition for approximately 30 seconds.

3. Reset the receiver to channel 640. The HIGH SIGNAL alarm lamp should extinguish and the buzzer should sound; silence the buzzer.

4. Repeat the signal-to-noise tests in (*b*) above. There should be no degradation in the signal-to-noise ratio results.

(*a*) Set the AC POWER switch on the transmitter to OFF and connect the test equipment as shown in figure 4–304.

(4) *Total harmonic distortion.*

(*b*) Set signal generator No. 2 frequency to 520 MHz as indicated on the frequency meter and set the output level to —54 dbm.

(c) Set the receiver controls as follows:

Controls	Settings
RCVR CHANNEL	Channel 640
RCVR SIG	Channel 640
XMTR DUPL	Channel 740
AC POWER	ON
Meter selector switch	MULT
MULT PEAK	Tune for maximum meter indication.
Meter selector switch	RCVR SIG
RCVR SIG	Tune for maximum meter indication.

(*d*) Record the noise level as indicated on the VTVM.

(*e*) Connect the test equipment as shown in figure 4–306.

(*f*) Disconnect the wide range oscillator.

(*g*) Set the AC POWER switch on the transmitter to ON/RESET. Set the transmitter to channel 740 and tune for maximum PWR OUT as described in (1)(*g*) and (*h*) above.

(*h*) Set the transmitter and receiver meter selector switches to their 24 CH PCM positions and the transmitter INPUT control to midrange.

(*i*) Set signal generator No. 1 to 50 MHz as indicated on the frequency meter and adjust its output level for a VTVM noise indication as obtained in (*d*) above.

(*j*) Reconnect the wide range oscillator; set the frequency of the wide range oscillator to 10 kHz and adjust its output level for a 50 percent indication on the transmitter meter. Record the wide range oscillator output level as indicated on its own meter. The receiver meter should indicate in the green band. The VTVM should indicate 265 mv ± 30 mv.

NOTE

Maintain the above wide range oscillator output level throughout the following tests.

(*k*) Record the level indicated on the distortion analyzer in the SET LEVEL position.

(*l*) Not used.

(*m*) Set the distortion analyzer to DISTORTION and check the total harmonic distortion. It should be at least 26 db below the level obtained in the SET LEVEL position ((*k*) above).

(*n*) Repeat (*j*) through (*m*) above at wide range oscillator frequencies of 250 Hz and 1.0 kHz.

(5) *Pcm performance test.*

(*a*) Set the AC POWER switch on the transmitter to OFF and connect the test equipment as shown in figure 4–304.

(*b*) Set signal generator No. 2 frequency to 520 MHz as indicated on the frequency meter and set the output level to —90 dbm.

(*c*) Set the receiver controls as follows:

Controls	Settings
RCVR CHANNEL	Channel 640
RCVR SIG	Channel 640
XMTR DUPL	Channel 740
AC POWER	ON
Meter selector switch	MULT
MULT PEAK	Tune for maximum meter indication.
Meter selector switch	RCVR SIG
RCVR SIG	Tune for maximum meter indication.

(*d*) Record the noise level as indicated on the VTVM.

(*e*) Connect the test equipment as shown in figure 4–307, with signal generator No. 1 connected as shown.

(*f*) Set the transmitter to channel 740 and tune for maximum PWR OUT as described in (1)(*g*) and (*h*) above.

(*g*) Disconnect the receiver test facility cable from the VIDEO connector of the transmitter.

(*h*) Set signal generator No. 1 frequency to 50 MHz as indicated on the frequency meter and adjust the output level to obtain the same VTVM noise level indication as in (*d*) above.

(*i*) Set test facility switches S1 to ON and S15 to PCM & TMG.

(*j*) Set the oscilloscope controls as follows:

TRIGGER	EXT
TIME/CM	.5 μsec
SWEEP MODE	NORMAL
VOLTS/CM (A & B)	.5

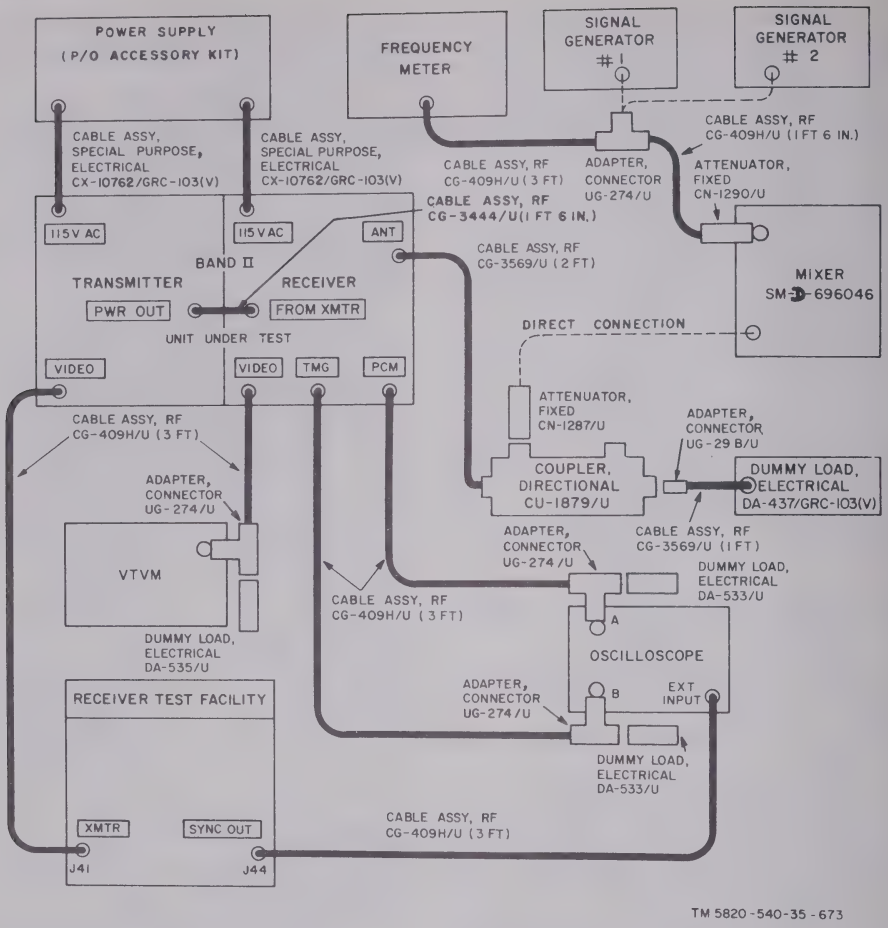


Figure 4–307. Band II radio set pcm performance, test setup.

(*k*) Set the transmitter and receiver meter selector switches to their 12 CH PCM position.

(*l*) Not used.

(*m*) Reconnect the receiver test facility to the transmitter VIDEO connector.

(*n*) Adjust the transmitter INPUT control for a 50 percent indication on the transmitter meter. The receiver should indicate within the green band. (This corresponds to 180 kHz deviation.)

(*o*) Observe the regenerated pcm signal and the timing pulse as displayed on channel A of the oscilloscope (fig. 4–308). Check the following pulse characteristics:

1. The regenerated pulse amplitude fig. 4–308) should be 2.0v ± 0.2v.

2. The timing pulse amplitude (B, 4–308) should be 2.0v ± 0.2v.

(*p*) Set both oscilloscope amplifiers 0.2v/cm dc. Check the following pulse characte tics:

1. The rise time should be between and 50 nanoseconds and the fall time betwee and 100 nanoseconds (C, fig. 4–308).

2. The timing pulse width (T2) sh be between 90 to 150 nanoseconds at 50 per amplitude.

3. The timing pulse rise time (10 to

ercent amplitude) should be between 10 and 50 anoseconds.

4. The timing pulse position relative to he regenerated pulse at 50 percent amplitude oints (T1) should be less than 80 nanoseconds D, fig. 4–308).

5. The difference T2–T1 should be less han 40 nanoseconds.

(6) *Order wire net gain measurement.*

(*a*) Connect the test equipment as shown in A, figure 4–309.

NOTE

Leave the transmitter tuned to channel 740 and the receiver to channel 640 as in the previous test.

(*b*) Set signal generator No. 1 to 50 MHz as shown on the frequency meter and adjust the output level for a VTVM noise level indication as recorded in (3)(*a*)*4* above (corresponding to a received signal of —74 dbm).

(*c*) Connect the test equipment as shown in B, figure 4–309.

(*d*) Set the coaxial switch to position 2.

(*e*) Set the wide range oscillator to 1.0 kHz and adjust the output level for —10 dbm as indicated on the VTVM.

(*f*) Set the coaxial switch to position 1. The VTVM should indicate —10 dbm +2.5 db —1.5 db. The 1-kHz tone should be heard on the order wire handset.

(7) *Order wire deviation test.*

(*a*) Connect the test equipment as shown in figure 4–310.

NOTE

Leave the transmitter tuned to channel 740 and the receiver to channel 640 as in the previous test.

(*b*) Set the coaxial switch to position 1.

(*c*) Set the wide range oscillator to 1.0 kHz and adjust the output level for a —10 dbm indication on the VTVM.

(*d*) Set the transmitter test facility switches S1 to ON and S20 to 30 MHZ DISCR.

(*e*) Set the coaxial switch to position 2.

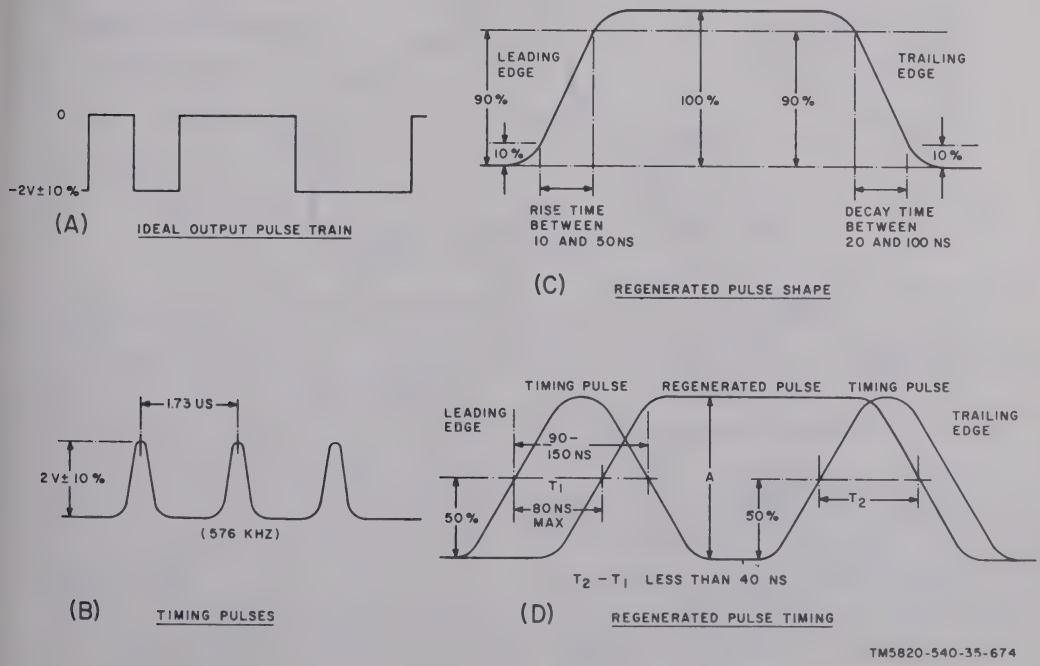


Figure 4–308. Pcm output pulses, oscilloscope display.

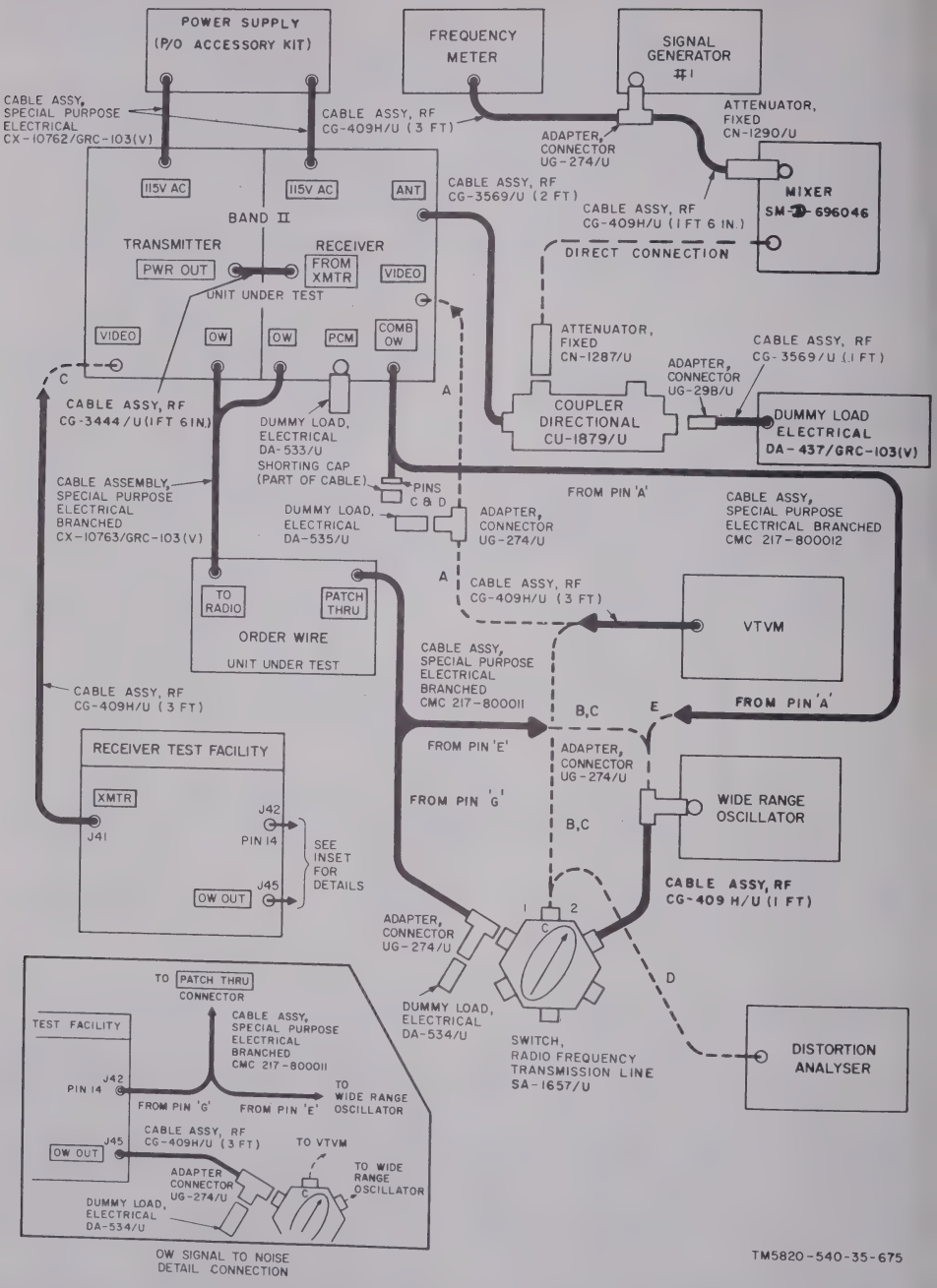


Figure 4-309. Order wire gain, noise level and distortion measurement, test setup.

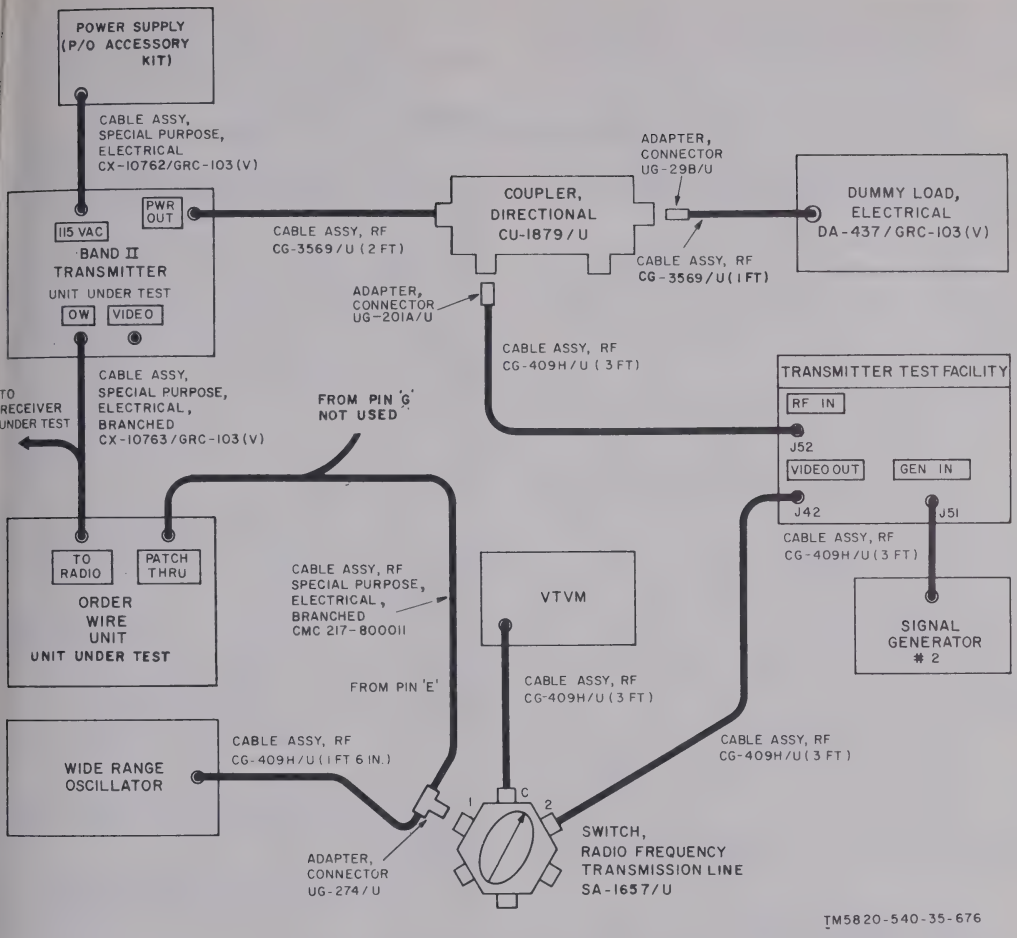


Figure 4–310. Order wire deviation, test setup.

(*f*) Set signal generator No. 2 frequency to 40 MHz at an output of 0 dbm.

(*g*) Observe test facility meter M1 and fine tune the signal generator for a peak indication. Adjust the attenuator on the signal generator to maintain the M1 indication at 50 percent of full scale. Further tune the signal generator for a midscale indication on test facility meter M2. The deviation as indicated by the unterminated VTVM should be between 39 and 58 mv rms (1.0 mv rms = 1.0 kHz peak deviation).

(8) *Order wire 12-channel pcm test.*

(*a*) Connect the test equipment as shown in C, figure 4–309.

(*b*) Set the coaxial switch to position 2.

(*c*) Set the wide range oscillator to 1.0 kHz (use the frequency meter) at an output of —10 dbm as indicated on the VTVM.

(*d*) Set the coaxial switch to position 1. The VTVM should indicate —10 dbm +2.5 —1.5 db.

(*e*) Set test facility switches S1 to ON and S15 to NOISE.

(*f*) Set the transmitter and receiver meter selector switches to their 12 CH PCM positions and the transmitter INPUT control to midrange.

(*g*) Adjust the test facility PCM LEVEL control for 50 percent indication on the transmitter meter. The receiver meter should indicate in the green band. The VTVM indication should be —10 dbm ± 2 db.

(*h*) Temporarily remove the 91-ohm load

from the receiver PCM connector. The receiver meter should drop to zero. Replace the 91-ohm load on the receiver PCM connector. The receiver meter should indicate within the green band.

(*i*) Set the coaxial switch to position 2.

(*j*) Increase the wide range oscillator output to 0 dbm as indicated on the VTVM.

(*k*) Set the coaxial switch to position 1. Record the VTVM indication.

(*l*) Not used.

(*m*) Disconnect the cable connection at the transmitter VIDEO connector. The VTVM should be within ± 1.0 db of the indication recorded in (*k*) above.

(9) *Order wire 24-channel pcm test.*

(*a*) Connect the test equipment as shown in C figure 4–309.

(*b*) Set the coaxial switch in position 2.

(*c*) Set the wide range oscillator to 1.0 kHz (use frequency meter) at an output of —10 dbm as indicated on the VTVM.

(*d*) Set the coaxial switch to position 1. The VTVM should indicate —10 dbm +2.5 db —1.5 db.

(*e*) Temporarily short circuit leads C and D of COMB OW special cable CMC 217–800012 (fig. 5–18). The VTVM indication should drop to zero. Remove the short circuit.

(*f*) Disconnect the PIN E lead of special cable CMC 217–800011 (fig. 5–18) from the wide range oscillator.

(*g*) Connect the PIN A lead of the COMB OW special cable to the wide range oscillator (E, fig. 4–309).

(*h*) Set the coaxial switch to position 2.

(*i*) Set the wide range oscillator to 1.0 kHz and adjust the output level to —4 dbm as indicated on the VTVM.

(*j*) Short circuit leads C and D of the COMB OW special cable.

(*k*) Set the coaxial switch to position 1. The VTVM indication should be —10 dbm ± 2 db.

(*l*) Not used.

(*m*) Remove the short circuit between lead C and D of the COMB OW special cable. The VTVM indication should drop to zero.

(10) *Order wire harmonic distortion measurement.*

(*a*) Connect the test equipment as shown in B, figure 4–309.

(*b*) Disconnect the test facility from the transmitter VIDEO connector and remove the 91-ohm load from the receiver PCM connector.

(*c*) Set the coaxial switch to position 2.

(*d*) Set the wide range oscillator to 1. kHz and adjust the output level to —10 dbm.

(*e*) Replace the VTVM with the distortio analyzer (D, fig. 4–309).

(*f*) Set the coaxial switch to position 1 The harmonic level should be at least 26 db belov fundamental as measured on the distortion ana lyzer.

(*g*) Replace the distortion analyzer with the VTVM as shown in B, figure 4–309.

(*h*) Repeat steps (*c*) through (*f*) above for a wide range oscillator output level of —5 dbm. The harmonic level should still be more than 26 db below the fundamental.

(11) *Order wire signal-to-noise measurement.*

(*a*) Connect the test equipment as shown in A, figure 4–309.

(*b*) Set signal generator No. 1 to 50 MHz and adjust the output for a VTVM noise level indication as in (3) (*a*)*5* above (corresponding to —94 dbm signal level).

(*c*) Connect the test equipment as shown in C, figure 4–309 and connect the test facility and the order wire unit to the coaxial switch as shown in the test facility detail connection inset.

(*d*) Set the deviation level as follows:

1. Set the test facility switches S1 to ON and S15 to NOISE.

2. Set the transmitter meter selector switch to 12 CH PCM and the INPUT control to midrange.

3. Disconnect the wide range oscillator.

4. Adjust the test facility PCM level control for a 50 percent indication on the transmitter meter.

5. Reconnect the wide range oscillator to the coaxial switch as in C, figure 4–309.

(*e*) Set the coaxial switch to position 2.

(*f*) Set the wide range oscillator to 1.0 kHz at a level of —10 dbm as indicated on the VTVM.

(*g*) Set the coaxial switch to position 1. Record the VTVM indication.

(*h*) Disconnect the wide range oscillator at the T-connector. The VTVM should indicate at least 29 db below the level obtained in (*g*) above.

(*i*) Reconnect the wide range oscillator.

(*j*) Disconnect the test facility from the transmitter VIDEO connector.

(*k*) Repeat (*g*) and (*h*) above. The difference between the two VTVM indications should be greater than 40 db.

(*l*) Not used.

(*m*) Repeat (*a*) through (*j*) above at a signal level of —74 dbm and —54 dbm as indicated by the VTVM noise levels measured in steps (3) (*a*)4 and (4) (*d*) above.

Section VII. REMOVAL AND REPLACEMENT PROCEDURES—BAND II RF HEADS

–140. Replacement of Connector-Filter Assembly 37AR1A1W1A1

onnector-filter assembly 37AR1A1W1A1 must be emoved in order to replace the filters next to the 7AR1 chassis, or to repair or replace 7AR1A1W1A1P1. The filters located on the side ot secured to the chassis may be replaced by emoving the side cover plate of 37AR1A1W1A1.

a. Place the transmitter RF head 37 right side p and locate the voltage regulator assembly 7AR1A1A1 (fig. 3–44). Loosen the four green ircled screws on the voltage regulator assembly nd remove the voltage regulator assembly.

b. Locate the connector-filter assembly 7AR1A1W1A1 (fig. 3–44). Measure as ccurately as possible and record the distance rom control panel 37MP1 to the rear edge of 7AR1A1W1A1.

c. Remove the four red-circled screws that ecure the 37AR1A1W1A1 to the chassis and nove the connector-filter carefully away from the hassis.

d. If the connector-filter assembly is to be hanged, unsolder and tag the wires connected to he filters FL1 to FL46. Remove the defective onnector-filter assembly and resolder the tagged vires to the replacement connector-filter assem-ly.

e. If a single filter is to be changed, unsolder the vires from both sides of the filter and remove the lefective filter. Install the replacement filter and onnect and solder the wires removed from the lefective filter.

f. Refer to paragraph 4–10 for replacement of onnector.

g. Replace connector-filter assembly 7AR1A1W1A1 using the four mounting screws emoved in *c* above. Position 37AR1A1W1 at the ame distance as measured in *b* above, and check he vertical plane of connector P1 using a small quare and the top edge of the 37AR1 (fig. 3–44) hassis as a reference. Tighten the four mounting crews.

h. Reinstall the voltage regulator assembly 7AR1A1A1 and tighten the 4 mounting screws.

4–141. Replacement of Radio Interference Filter 37AR1A1FL2

a. Place amplifier-frequency multiplier 37 right-side up and locate radio interference filter 37AR1A1FL2 (fig. 3–44).

b. Remove the two screws securing the red cover plate to the filter; remove the red cover plate.

c. Unsolder and tag the three wires from connecting pins E1, E2, and E3.

d. Remove the two screws securing the radio interference filter and remove the filter.

e. Position the replacement filter and secure it with the two screws removed in *d* above.

f. Remove the two screws securing the red cover plate on the replacement filter; remove the red cover plate.

g. Place a suitable length of heat shrinkable tubing type CMC 334–362/3 over each wire to be connected to E1, E2, and E3.

h. Wrap the wires around both sides of the hook terminals on the radio interference filter. Insure a good mechanical connection and solder leads to the terminals.

i. Position the heat shrinkable tubing on the wires over the soldered terminals. Use a thermo-gun to shrink the tubing over the terminals.

j. Replace the red cover plate and secure with the screws removed in *f* above.

4–142. Replacement of Control Panel 37MP1

a. Removal Procedure.

(1) Remove the XMTR TUNE and the PWR OUT PEAK control knobs.

(2) Remove the hexagon nut and the flat washer from the PWR OUT connector.

(3) Loosen the two screws that secure plug P1(37AR1A1W1J3) (fig. 3–42) to its mating connector 37AR1A1W1J3 and disconnect the plug.

(4) Loosen and remove the six green-circled mounting screws and washers located at the rear of the control panel, and remove the control panel.

NOTE

Pull the panel forward from the RF head to release it from the guiding pin.

b. Replacement Procedure.

(1) Place the control panel in position and press to slide home the guiding pin.

NOTE

It may be necessary to loosen the four screws holding the power monitor 37AR1A2 (fig. 3–42) in position. Do not re-tighten screws at this time.

(2) Secure the control panel to the chassi using the 6 screws removed in *a*(4) above.

(3) Connect P1(37AR1A1W1J3) of th control indicator 37A2 to connecto 37AR1A1W1J3 and secure the plug in positio with the two screws provided.

(4) Replace and secure the nut and washer t

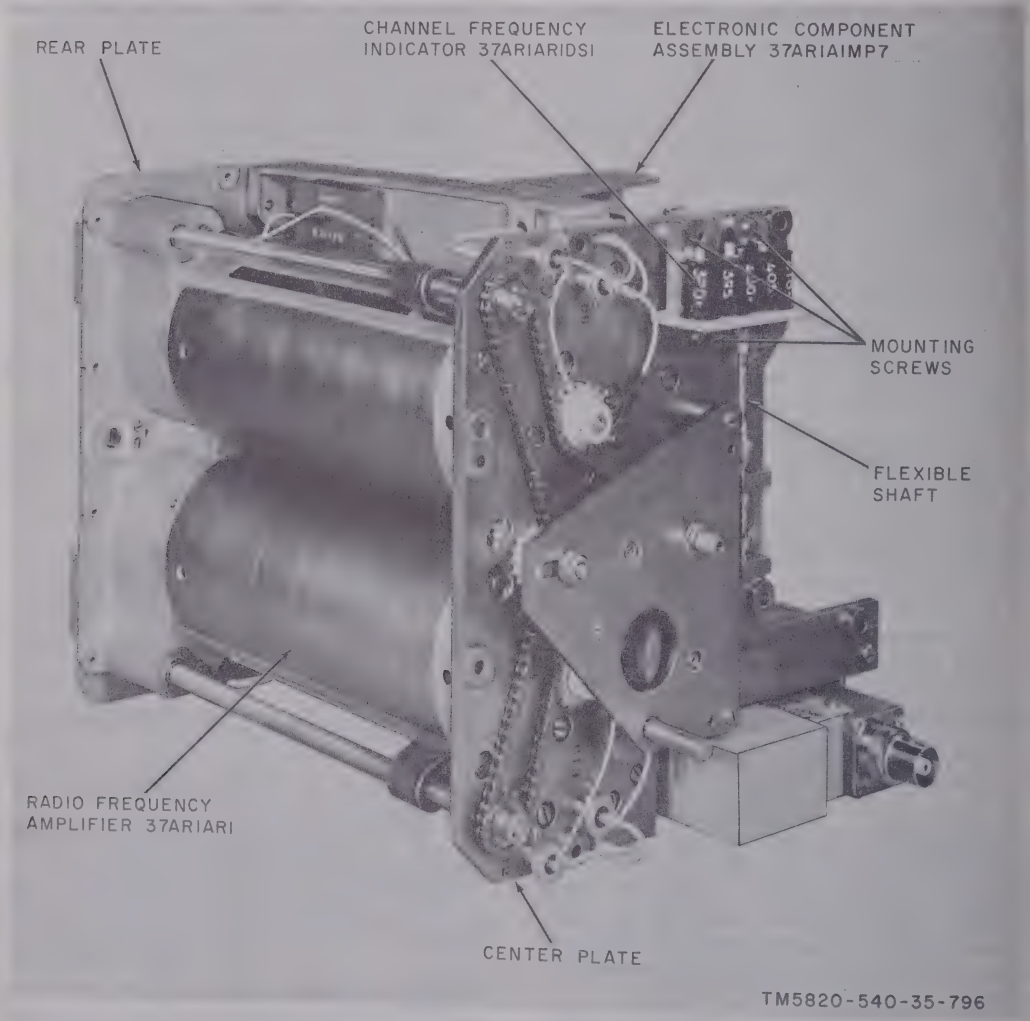


Figure 4–311. Band II Transmitter RF head, front view, front panel removed.

he PWR OUT connector. Tighten the power mon-
or 37AR1A2 mounting screws.

(5) Install the XMTR TUNE and PWR OUT
EAK control panel knobs.

–143. Replacement of Channel Frequency Indicator 37AR1AR1DS1

a. Removal and Replacement Procedure.

(1) Remove control panel 37MP1 as described in paragraph 4–142.

(2) Reconnect the XMTR TUNE knob to the shaft of the XMTR TUNE control. Turn the XMTR TUNE control fully clockwise to the stop.

(3) Locate the channel frequency indicator (fig. 4–311). Remove the three red-circled screws that secure the channel frequency indicator to the chassis.

(4) Grasp the channel frequency indicator and slide it sideways to disengage the flexible shaft from the hexagonal shaft. Remove the defective channel frequency indicator.

(5) Remove the flexible shaft from the defective channel frequency indicator by removing the straight pin through the end of the shaft.

(6) Slide the flexible shaft on to the hexagonal shaft.

(7) Turn the replacement channel frequency indicator until the white cross hatch (above channel 1010) on the tape is aligned with the calibration mark (notch) on the frame.

(8) Slide the replacement channel frequency indicator sideways to connect the shaft of the channel frequency indicator to the free end of the flexible shaft.

(9) Secure the channel frequency indicator with the three screws removed in *a*(3) above.

(10) Position the flexible shaft midway between the channel frequency indicator and the hexagonal shaft. Secure the flexible shaft to the channel frequency indicator using setscrews. (Do not drill and pin flexible shaft in position at this time.)

b. Channel Alignment Check and Adjustment.

(1) Connect control indicator plug P1(37AR1A1W1J3) (fig. 3–42) on the control panel to connector 37AR1A1W1J3 on the transmitter RF head chassis.

(2) Connect the test equipment as shown in A, figure 4–198.

(3) Turn XMTR CHANNEL control to channel 390 (395 MHz).

(4) Turn XMTR TUNE control to channel 390.

(5) Set test facility switches S1 to ON, S20 to S12, and S12 to OSC.

(6) Install the PWR OUT PEAK knob to the shaft of the PWR OUT PEAK control.

(7) Adjust the PWR OUT PEAK control two-thirds of a rotation away from the fully clockwise position.

(8) Adjust the XMTR TUNE control for a maximum power indication on the wattmeter.

(9) Check that the PWR OUT PEAK control is capable of tuning the power output both sides of the peak power indication. Readjust the XMTR TUNE and the PWR OUT PEAK control, if necessary, to obtain this capability.

(10) Check the channel frequency indicator; channel 390 should not be more than ⅛ inch above or below the calibration mark (notch) on 37AR1AR1DS1.

CAUTION

Insure that the flexible shaft does not move during the adjustment in (11) below.

(11) If the channel frequency indication is more than ⅛ inch removed from the calibration mark, loosen the two setscrews holding the flexible shaft to the channel frequency indicator and adjust the channel frequency indicator until the channel indication (390) is aligned with the calibration mark.

(12) Tighten the setscrews to secure the flexible shaft to the channel frequency indicator. Drill the shaft of the channel frequency indicator shaft using the pilot hole provided. Pin the flexible shaft.

(13) Check the alignment at channels 450, 550, 650, 750, 850 and 1000 as shown in steps (3), (4), (8), and (9) above. Check that the channel number of the channel being checked is not more than ½ inch above or below the calibration mark.

(14) Remove the XMTR TUNE and PWR OUT PEAK knobs and disconnect P1(37AR1A1W1J3) from connector 37AR1A1W1J3. Install control panel 37MP1 as described in paragraph 4–142 *b*.

4–144. Replacement of Resistor Assembly 37AR1A1A2

a. Turn transmitter RF head left side up and locate resistor assembly 37AR1A1A2 (fig. 3–42).

b. Unsolder and tag leads connected to terminal E1.

c. Remove the two green-circled screws that secure the resistor assembly to the chassis; remove the resistor assembly.

d. Secure the replacement resistor assembly to the chassis using the two screws removed in *c* above.

e. Place a suitable length of heat shrinkable tubing type CMC 334–362/3 over the wires removed in *b* above.

f. Connect and solder the wires to the terminal E1. Position the heat shrinkable tubing on the wires over the terminal. Use a thermogun to shrink the tubing over the terminal.

4–145. Replacement of Frequency Multiplier 37A1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Wattmeter AN/URM–120	Wattmeter

b. Removal and Replacement Procedure.

(1) Place the transmitter RF head upright and locate frequency multiplier 37A1 (fig. 3–42). Disconnect the 37AR1A1W1A1P2 and P1(37A1J2) RF leads connected to frequency multiplier 37A1.

(2) Loosen the four red-circled screws that secure the frequency multipler 37A1 to th chassis. Pull 37A1 straight up, carefully disenga ing P1(37AR1A1W1J2) from the chassis conne tor 37AR1A1W1J2. Slide 37A1 away from th front panel to disengage the flexible shaft.

(3) Set the transmitter RF head XMT TUNE and XMTR CHANNEL controls t channel 1010.

NOTE

The 37A1 replacement module is shipped with its shaft clamped to channel 1010 (705 MHz). Remove the clamp carefully to avoid disturbing the shaft position.

(4) Lower the 37A1 replacement module int position carefully engaging the flexible shaft to its drive mechanism. Carefully engage P1(37AR1A1W1J2) to chassis connecto 37AR1A1W1J2.

(5) Secure 37A1 to the chassis with the fou screws provided.

(6) Reconnect RF leads 37AR1A1W1A1P2 and P1(37A1J2) to 37A1J1 and 37A1J2 (fig 3–42) respectively.

c. Alignment Check.

(1) Connect the equipment as shown in figure 4–311.1.

(2) Direct cooling air from the AIR OUTLET of the transmitter test facility to the rear of the unit under test.

(3) With the XMTR TUNE and XMTR CHANNEL controls set to channel 1010, set the test facility switches as follows:

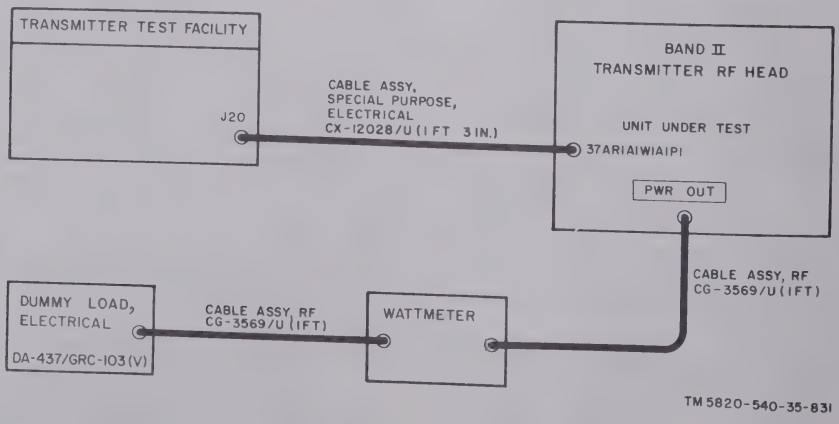


Figure 4–311.1 Frequency multiplier 37A1 alignment check, test setup.

Switch	Switch position	Normal indication
	ON	
3	ON	
20	S12	
12	OSC	Meter M1 indicates between 20% and 90% of full scale.

(4) Turn test facility switch S12 to PWR OUT and adjust PWR OUT PEAK control for maximum indication on the test facility meter M1.

(5) Adjust the XMTR TUNE and PWR OUT PEAK controls for maximum indication on the wattmeter. The wattmeter should indicate at least 25 watts. The XMTR TUNE channel indication should be within 0.5 inch of the centerline of the display window.

(6) Repeat steps (4) and (5) above with the XMTR CHANNEL and XMTR TUNE controls set to channels 390, 400, 480, 560, 640, 720, 760, 800, 880, 960 and 1000 in turn.

(7) Select the channel giving the highest error above ± 0.5 inch on the XMTR TUNE channel indicator tape. Set the XMTR CHANNEL control to the channel selected.

(8) Set the test facility switch S12 to MULT and tune the XMTR TUNE control for maximum indication on the test facility meter M1.

(9) Set the test facility switch S1 to OFF and remove 37A1 as described in steps *b* (1) and (2) above.

(10) Turn the XMTR TUNE control until the channel selected in step (7) above is on the window center line.

(11) Repeat steps *b* (4) and (5) to reinstall 37A1.

(12) Set the test facility switch S1 to ON and repeat step (6) above.

4–146. Replacement of Radio Frequency Amplifier 37AR1AR1

a. Removal Procedure.

(1) Set XMTR TUNE to channel 1010. To remove radio frequency amplifier 37AR1AR1 the following modules must be removed first:
Low pass filter 37AR1A1FL1 (para 3–90).
RF power monitor 37AR1A2 (para 3–91).
Voltage regulator assembly 37AR1A1A1 (para 3–92).
Connector filter assembly 37AR1A1W1A1 (para 4–140).
Radio interference filter 37AR1A1FL2 (para 4–141).
Control panel 37MP1 (para 4–142).
Channel frequency indicator 37AR1AR1DS1 (para 4–143).
Resistor assembly 37AR1A1A2 (para 4–144).
Frequency multiplier 37A1 (para 4–145).

(2) Remove the mounting screws on chassis connectors 37AR1A1W1J2, 37AR1A1W1J3, 37AR1A1W1J4 (fig. 3–42) and 37AR1A1W1J5. Remove the connectors complete with the wiring harness.

(3) Unsolder and tag wires from 37AR1AR1C7 (fig. 3–42) and 37AR1AR1C14 (fig. 3–44).

(4) Remove the clips holding the rigid cables to the chassis, and remove the rigid cables.

(5) Remove the four pins that secure the electronic component assembly chassis 37AR1A1MP7 (fig. 4–311) to the center plate and rear plate.

(6) Remove the three red-circled screws holding 37AR1A1MP7 to the center plate.

(7) Remove the four red-circled mounting screws securing 37AR1A1MP7 to the rear plate.

(8) Pull the electronic component assembly chassis 37AR1A1MP7 away from the radio frequency amplifier 37AR1AR1.

b. Replacement Procedure.

(1) Place electronic component assembly chassis 37AR1A1MP7 in its position over the radio frequency amplifer 37AR1AR1 and secure it to the center plate and rear plate with four pins.

(2) Replace the three red-circled screws that secure the electronic component assembly chassis to the center plate.

(3) Secure the chassis to the rear plate with four red-circled screws.

(4) Replace the rigid cables in position and secure them to the chassis with the clips removed in *a* (4) above.

(5) Slide a piece of heat shrinkable tubing CMC 334–362/3 over each of the two wires connected to 37AR1AR1C7 and 37AR1AR1C14 (fig. 3–44) and solder the wires to their respective capacitors. Slide the tubing over the soldered portions and shrink it with a thermogun.

(6) Position chassis connectors 37AR1A1W1J2, 37AR1A1W1J3, 37AR1A1W1J4

and 37AR1A1W1J5 in their respective places. Secure in position with the mounting screws provided.

(7) Replace the following modules in the order given:

Frequency multiplier 37A1 (para 4–145 *b*).

Resistor assembly 37AR1A1A2 (para 4–144).

Channel frequency indicator 37AR1AR1DS1 (para 4–143).

Control panel 37MP1 (para 4–142).

Radio interference filter 37AR1A1FL2 (para 4–141).

Connector-filter assembly 37AR1A1W1A1 (para 4–140).

Voltage regulator assembly 37AR1A1A1 (para 3–92).

RF power monitor 37AR1A2 (para 3–91).

Low-pass filter 37AR1A1FL1 (para 3–90).

(8) Repeat paragraph 4–145 *c*.

4–147. Replacement of Signal Distribution Panel 33A6

a. Place the receiver RF head top side up and locate signal distribution panel (control panel) 33A6 (fig. 3–49).

b. Locate and loosen the two screws that secure P1(33A1W1J5) to 33A1W1J5 (fig. 3–49). Remove P1(33A1W1J5).

c. Loosen the screws in the MULT PEAK, RCVR SIG and XMTR DUPL control panel knobs and remove the knobs.

d. Using a socket wrench, remove the two nuts and washers that secure the ANT. and FROM XMTR connectors to the control panel. Pull the connectors away from the control panel.

e. Loosen the eight mounting screws that secure control panel 33A6 to the chassis. Remove the control panel.

f. To reinstall 33A6, place the control panel in the correct position on the chassis so that the mounting holes are properly aligned. Secure control panel 33A6 with the eight mounting screws.

g. Insert the connectors through the ANT. and FROM XMTR mounting holes and secure them with the nuts and washers removed in step *d* above.

h. Replace and secure the MULT PEAK, RCVR SIG and XMTR DUPL control knobs. Make sure that the backs of the RCVR SIG and XMTR DUPL knobs clear the control panel by ⅛ inch.

i. Connect P1(33A1W1J5) to 33A1W1J5 and secure the plug in position with the screws.

4–148. Replacement of Channel Frequency Indicator 33A1A1DS1 or 33A1A1DS2

a. Remove front panel 33A6 as described in paragraph 4–147.

b. Remove the three red-circled mounting screws that secure the defective channel frequency indicator (33A1A1DS1 or 33A1A1DS2, fig. 4–227) to the chassis.

c. Grasp channel frequency indicator and slide it sideways to disengage the flexible shaft. Remove the defective channel frequency indicator.

d. Remove the pin through the flexible shaft and remove the flexible shaft from the defective channel frequency indicator.

e. Install the flexible shaft on the replacement channel frequency indicator and secure with a setscrew.

f. Install the RCVR SIG control knob if 33A1A1DS1 is being replaced, or XMTR CHANNEL control knob if 33A1A1DS2 is being replaced.

g. Turn the control knob clockwise to the stop position.

h. Turn the flexible shaft, on the replacement channel frequency indicator, clockwise until the start position, indicated by an arrow head and the letter "S," is aligned with the calibration mark. The calibration mark is a notch centrally located on the front edge of the unit's frame.

i. Place the channel frequency indicator in position and slip the hexagonal recessed end of the flexible shaft over the coupling shaft (fig. 4–227).

j. If the stop position of the channel control and the start position on the tape do not coincide, proceed as follows:

(1) Loosen the setscrew in the flexible shaft.

(2) Ensure that the channel control is turned fully clockwise.

(3) Adjust the tape to realign the start position as in step *h* above.

(4) Retighten the setscrew securing the flexible shaft.

k. Remove the channel frequency indicator.

Using the guide holes in the flexible shaft, drill a hole through the channel frequency indicator shaft. Press a pin through both shafts. Remove the setscrew.

l. Not used.

m. Reinstall the channel frequency indicator and secure in position with the three mounting screws.

4-149. Replacement of RF Power Monitor 33A3

NOTE

Signal distribution panel 33A6 must be removed (para 4-147) in order to permit replacement of RF power monitor 33A3.

a. Place the receiver RF head front side up and locate the RF power monitor 33A3 (fig. 4-227).

b. Locate and loosen the two screws that secure P1(33A1W1J3) to 33A1W1J3 (fig. 4-227). Remove P1(33A1W1J3) plug.

c. Disconnect P2(33A3J1) and P1(33A3J2) (fig. 4-227) from the J1 and J2 connectors of 33A3.

d. Locate and remove the four mounting screws that secure the RF power monitor 33A3 to the chassis.

e. Lift the RF power monitor complete with cable from the chassis.

f. To install the replacement module, position 33A3 in its place and secure it with the four mounting screws.

g. Connect P1(33A3J2) RF lead to connector J2 and P2(33A3J1) RF lead to connector J1 of RF power monitor 33A3.

h. Connect P1(33A1W1J3) plug to 33A1W1J3 chassis connector. Secure in position with the screws provided.

i. Replace signal distribution panel 33A6 (para 4-147).

4-150. Replacement of Connector-Filter Assembly 33A1W1A1

a. Place the receiver RF head rear side up and locate connector-filter assembly 33A1W1A1 (fig. 4-312).

CAUTION

The two locating pins on the sides of 33A1W1A1 are factory aligned and should never be loosened or removed.

b. Remove the four screws that secure 33A1W1A1 to the chassis. Pull 33A1W1A1 free of the chassis.

c. Replace filter-connectors as required. Refer to paragraph 4-9 and figure 7-8 for replacement of filter-connectors.

d. If 33A1W1A1P1 requires replacement, unsolder and tag the wires from the pins.

e. Remove the four screws that secure 33A1W1P1 to the assembly; remove 33A1W1P1 from the assembly.

f. Install the replacement 33A1W1P1 and secure it with the four mounting screws provided.

g. Connect and solder the wires removed in *d* above. Refer to paragraph 4-10 and figure 7-8 for connections.

h. Place 33A1W1A1 in position on the chassis and secure it with the four screws removed in *b* above.

4-151. Replacement of Speed Decreaser Gear Assembly 33A1MP1

a. Loosen the screws in the MULT PEAK knob on the front panel. Remove the knob.

b. Loosen the two screws in the coupling shaft (fig. 3-49) that secure the speed decreaser gear assembly shaft.

c. Place the receiver RF head right side up and locate the speed decreaser gear assembly 33A1MP1 (fig. 3-53). Unscrew the three red-circled screws and remove the speed decreaser gear assembly 33A1MP1.

d. To install the replacement speed decreaser gear assembly 33A1MP1, place it in position over the three mounting holes. MULT PEAK shaft should project from the hole on the front panel and the speed decreaser gear shaft should fit into the coupling shaft.

e. Tighten the three red-circled mounting screws.

f. Tighten the two screws in the coupling shaft.

g. Replace and secure the MULT PEAK knob.

h. Align the amplifier-converter unit 33 as described in paragraph 4-118 *d*.

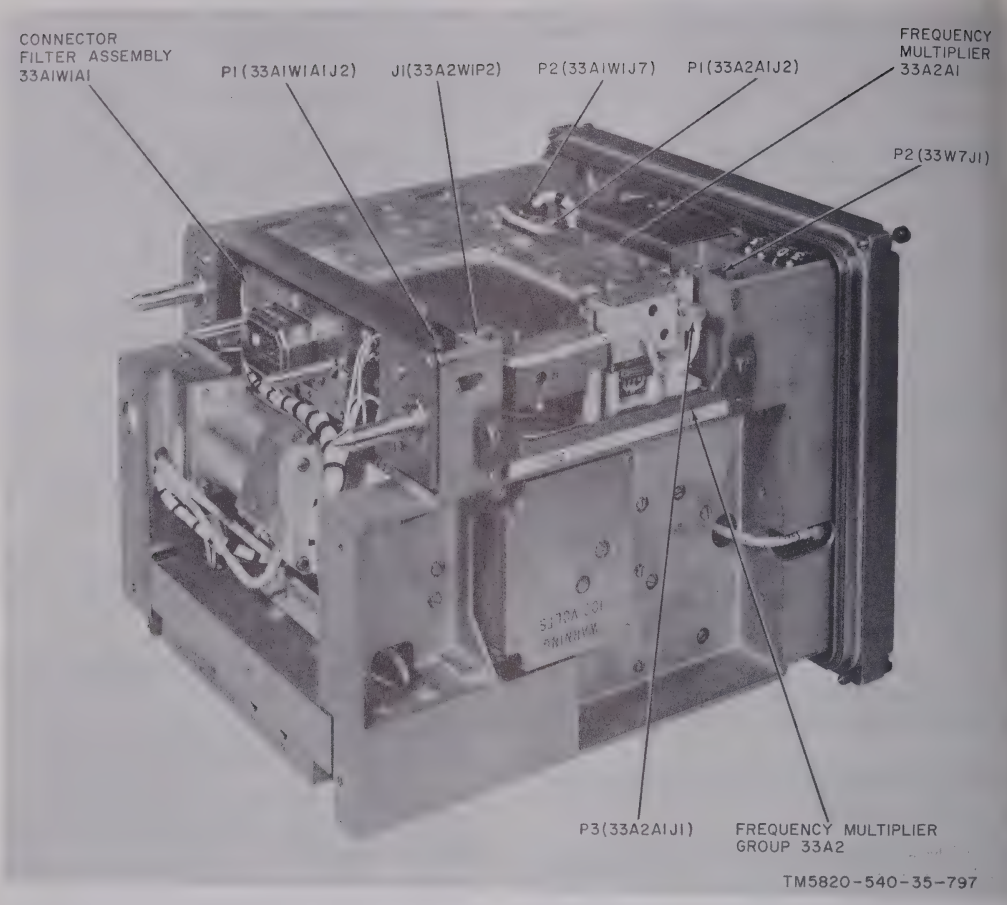


Figure 4–312. Band II receiver RF head, top and left-hand side view.

NOTE

It should not be necessary to perform the alginment procedures of the voltage control assembly 33A1A2.

4–152. Replacement of Frequency Multiplier Group 33A2

a. Place the receiver RF head upright and locate the muliplier group 33A2 (fig. 4–312).

b. Disconnect RF leads P1 (33A1W1A1J2) and P2(33W7J1) (fig. 4–312) from their respective connectors.

c. Locate and loosen the two screws that secure P2(33A1W1J7) (fig. 4–312) to chassis connector 33A1W1J7. Disconnect P2(33A1W1J7) plug.

d. Loosen the two setscrews in the coupling shaft (fig. 3–49) that secure the speed decreaser gear assembly shaft to the 33A2 tuning shaft.

e. Place the receiver RF head right side up. Locate and unscrew four red-circled mounting screws securing the multiplier group 33A2.

f. Place the receiver RF head left side up. Located and unscrew the remaining two red-circled mounting screws securing the multiplier group 33A2.

g. Lift the frequency multiplier group 33A2 straight up.

h. To reinstall the replacement module, lower the frequency multiplier group straight down in its position engaging the coupling shaft. Replace

d tighten the two red-circled screws securing e module to the left side of the chassis. Tighten e setscrews in the coupling shaft. Replace and ghten the four remaining red-circled screws curing the module to the right side of the assis.

i. Connect RF leads P1(33A1W1A1J2) and 2(33W7J1) to their respective connectors.

j. Connect plug P2(33A1W1J7) to chassis nnector 33A1W1J7 and secure in position with e screws provided.

k. Realign the band II receiver RF head as escribed in paragraph 4–118 *d* (1), (2), and (4).

4–153. Replacement of Frequency Multiplier 33A2A1

a. Set the receiver RF head RCVR SIG control o channel 390. Place the receiver RF head upright and locate frequency multiplier 33A2A1 (fig. 4–312).

b. Locate and disconnect the RF leads P3(33A2A1J1) and P1(33A2A1J2) from their respective connectors on 33A2A1.

c. Locate the bevel gear of frequency multiplier 33A2A1 (fig. 3–49) (gear A, fig. 4–234) and loosen the setscrews holding the gear to the shaft.

d. Locate and loosen the three red-circled mounting screws of the frequency multiplier 33A2A1.

e. Lift the frequency multiplier 33A2A1, carefully disengaging the gears and disengaging P1(33A1FL1W1J2) from its mating connector.

f. To install the frequency multiplier 33A2A1, position the replacement module over its mounting holes, carefully engaging the gears and the mating connectors P1(33A2FL1W1J2) and 33A2FL1W1J2. Tighten the three red-circled mounting screws.

g. Connect RF leads P3(33A2A1J1) to J1 of 33A2A1 and P1(33A2A1J2) to J2 of 33A2A1.

h. Disconnect RF leads P1(33A1W1A1J2) and P2(33W7J1) (fig. 4–312) from their respective connectors.

i. Locate and loosen the two screws that secure P2(33A1W1J7) (fig. 4–312) to chassis connector 33A1W1J7. Disconnect P2(33A1W1J7) plug.

j. Realign the frequency multiplier group as described in paragraph 4–122 *d*. Rotate gear A (fig. 3–53) to turn shaft C where required in the alignment procedures.

k. Reconnect RF leads P1(33A1W1A1J2) and P2(33W7J1) and plug P2(33A1W1J7) to their respective connectors.

l. Not used.

m. Realign the frequency multiplier group with the receiver RF head as described in paragraph 4–118 *d* (1), (2), and (4).

4–154. Replacement of Bandpass Filter 33A2FL1 and Terminal Board 33A2FL1W1TB1

a. Removal of Bandpass Filter 33A2FL1.

(1) Remove the following units in the order given below.

Frequency multiplier 33A2A2 (para 3–94 *a*, *b*, and *c*).
Frequency multiplier 33A2A1 (para 4–153 *a*, *b*, *d*, and *e*).

(2) Locate and loosen the screws on P2(33A1W1J7) (fig. 4–312) and disengage it from its mating connector. Disconnect the RF leads P1(33A1W1A1J2) and P2(33W7J1). Loosen the two setscrews in the coupling shaft (fig. 3–49).

(3) Place the receiver RF head right side up. Locate and loosen the four red-circled mounting screws of multiplier group 33A2.

(4) Place the receiver RF head left side up. Locate and unscrew the two red-circled mounting screws of multiplier group 33A2.

(5) Ease the bandpass filter 33A2FL1 (multiplier group 33A2 less frequency multiplier 33A2A1 and frequency multiplier 33A2A2) away from the chassis.

b. Removal of Terminal Board 33A2FL1W1TB1.

(1) Remove the mounting screws of chassis connectors 33A2FL1W1J2 and 33A2FL1W1J3 (fig. 4–253).

(2) Remove the three cable clips holding the wiring harness to the chassis.

(3) Unsolder and tag the wires connected to the terminal board.

(4) Remove the two mounting screws holding 33A2FL1W1TB1 to the chassis.

c. Replacement of Bandpass Filter 33A2FL1 and Terminal Board 33A2FL1W1TB1.

(1) Position the replacement terminal board and tighten in place with two mounting screws.

(2) Solder the wires to the terminals of 33A2FL1W1TB1 (fig. 7-6).

(3) Place the branched wiring harness in its position and secure it to the chassis with the three clips removed in *b* (2) above.

(4) Position chassis connectors 33A2FL1W1J2 and 33A2FL1W1J3 and secure them to the chassis with the mounting screws provided.

(5) Install and secure frequency multiplier 33A2A2 to the bandpass filter 33A2FL1 (fig. 4-234). Connect plug P2(33A2A2J1) to J1 on 33A2A2.

(6) Install and secure frequency multipler 33A2A1 to the bandpass filter 33A2FL1 (fig. 4-234), carefully engaging gear D with the gear on shaft C.

(7) Connect RF leads P3(33A2A1J1) to J1 of 33A2A1 and P1(33A2A1J2) to J2 of 33A2A1.

(8) Realign the frequency multiplier group as described in paragraph 4-122 *d*.

(9) Install and realign the frequency multiplier group with the receiver RF head as described in paragraph 4-152 *h* through *k*.

4-155. Replacement of Voltage Control Assembly 33A1A2

Deleted.

4-156. Replacement of Terminal Board 33A1W1TB1

a. Remove intermediate frequency amplifie 33AR1 (para 3-96) and frequency mixer stag 33A7 (para 3-97).

b. Locate and loosen the mounting screws o chassis connectors 33A1W1J8 and 33A1W1J (fig. 3-56). Push these connectors down through the holes provided in the bottom support.

c. Remove the six mouting screws of the bottom support. Remove the bottom support.

d. Unsolder and tag the wires attached to the terminal board 33A1W1TB1.

e. Remove the two mounting screws that secure the defective terminal board to the bottom support.

f. Mount the replacement terminal board in its position and tighten the two mounting screws.

g. Solder the wires to the replacement terminal board. Refer to wiring diagram figure 7-7, if necessary.

h. Place the bottom support in its position and pull the connectors 33A1W1J8 and 33A1W1J9 up through the holes provided. Secure the bottom support with six mounting screws.

i. Secure the two chassis connectors 33A1W1J8 and 33A1W1J9 to the bottom support with the mounting screws provided.

j. Replace frequency mixer stage 33A7 (para 3-97) and intermediate frequency amplifier 33AR1 (para 3-96).

Section II. MODULE TEST AND ALIGNMENT PROCEDURES, BAND III RF HEADS

4-157. General

a. This section covers depot maintenance of Amplifier-Frequency Multiplier AM-4322/GRC-103(V) (band III transmitter RF head) and Amplifier-Converter AM-4318/GRC-103(V) (band III receiver RF head). Repair and overhaul of band III RF heads mechanical assemblies are covered in chapter 5. This section lists the tools and test equipment required to test and repair the band III transmitter and receiver RF heads. It also covers all tests and alignments performed at system and unit level for Radio Set AN/GRC-103(V)3, and at module level for band III RF heads only.

b. The following test procedures are based on the use of Test Facilities Set AN/GRM-95(V)1. Cables, adapters, filters and similar accessories that are required for tests but are not listed in the appropriate *Test Equipment and Material Required* paragraph are part of Test Facilities Set AN/GRM-95(V)1.

4-158. Additional Test Equipment and Material Required

a. The following chart lists the test equipment, cables, connectors and special tools required for the depot maintenance of band III RF heads in addition to the list contained in paragraph 4-2.

NOTE

Cables, connectors and other accessories included in the test facility are not listed in this paragraph.

b. Test Equipment.

Equipment	Common name
Generator, Signal SG-409( )/U.	Signal generator No. 1
Generator, Signal SG-340A/G	Signal generator No. 2
Generator, Signal SG-644/U	Signal generator No. 3
Generator, Sweep SG-888	Sweep generator
Generator, Thermal Noise PRD-904.	Noise generator
Generator, Thermal Noise SG-427/U and Power Supply.	High frequency noise generator.
Frequency Meter AN/USM-159.	Frequency meter
Drive Generator, Airborne Instruments Lab, Model 125.	Power signal source
Power Supply Lambda LK-342FM.	Variable power supply
Power Supply Lambda LP-412FM.	Variable power supply
Voltmeter, Electronic ME-247/U.	RF voltmeter
Voltmeter, Vector Hewlett-Packard 8405A.	Vector voltmeter
Accessory Kit, Vector Voltmeter Hewlett-Packard 11570A.	50-ohm loads and 50-ohm 'T's.
Wave Analyzer, Bruel and Kjoer 2107.	Wave analyzer
VSWR Bridge ANZAC RB-3	VSWR bridge RB-3
Resistance Bridge ZM-4/U	Resistance bridge
Test Set, Analyzer Breakdown Voltage AN/GSM-6.	Breakdown voltage tester
Capacitance, Resistance, Inductance Test Set AN/URM-90.	R-L-C bridge
Detector RF XD-23A	Detector XD-23A
Trombone Line General Radio 874-LTL	Trombone line 874-LTL
Circulator Melab HD-1-450	Circulator
Dummy Load 50 ohms, 50 watts SM-A-697452 (3 required).	50-ohm load, 50 watts SM-A-697452
Power Supply Test Jig SAC-SK-005.	Test jig
Dummy Load CMC 335-053	51-ohm load
Shorting Tool SAC-SK-007	
Alignment Gage SAC-SK-026	Alignment gauge
Dummy Plate SAC-SK-008	
Wideband RF Amplifier SAC-SK-012.	Wideband RF amplifier
Band III Receiver Multiplier Tuning Law Test Jig SM-D-696026	
Transmitter Amplifier-Frequency Multiplier Test Jig SAC-SK-023.	
Low Pass Filter SM-C-696031	
30-MHz Gaussian Filter SM-A-698149	
Mixer SMD-696046	
Band III Bandpass Filter Tuning Law Test Jig SM-E-696048.	Test jig
Hybrid Junction, Anzac H-8	
Wideband RF Amplifier Test Jig SM-C-696030.	
50 ohm Load Omni Spectra 20020P (2 requred).	50-ohm load OS20020P
Filter, Low-Pass TLC-1000-5EF (2 required).	Filter TLC-1000-5EF
Filter, Low-Pass TLC-290-5EF.	Filter TLC-290-5EF
Tunable Bandpass Filter Telonic TTF-1000-5-3EE.	Tunable filter 750-1500 MHz.
Tunable Bandpass Filter Telonic TTF-1500-5-5EE.	Tunable filter 1000-2000 MHz.
Tunable Bandpass Filter Telonic TTF-500-5-5EE.	Tunable filter 375-750 MHz
Tunable Bandpass Filter Telonic TTF-750-5-5EE.	Tunable filter 500-1000 MHz
Dummy Load Hewlett-Packard 908A.	Dummy Load HP-908A
Dummy Load Telonic TRM-1-1.60F.	Calibrated mismatch TRM-1-1.60.
Dummy Load Telonic TRM-1-1.30F.	Calibrated mismatch TRM-1-1.30.
Dummy Load Telonic TRM-1-3.50F.	Calibrated mismatch TRM-1-3.50.
Attenuator, Fixed Weinschel 693-30.	20-db 30-watt attenuator
Resistor, Variable 0-1 ohm, 20 watts.	1-ohm variable resistor
Resistor, Variable 0-12 ohms, 50 watts.	12-ohm variable resistor
Resistor, Fixed 10k ohms, ½ watt.	10k-ohm fixed resistor
Attenuator Fixed, 20 DB, 50W Empire Devices, Inc. Model AT-70.	20-db, 50 watt attenuator AT-70.
Dummy Load, Electrical DA-437/GRC-103(V).	
Amplifier, GP LA-2300-43	Low noise IF amplifier

Equipment	Common name
Adapter-Connector UG–57B/U.	
Adapter-Connector UG–107B/U.	
Frequency Mixer Stage Test Jig SM-E -696028.	Mixer test jig
Adapter-Connector Hewlett-Packard 11536A.	Adapter-connector HP11536A.
Adapter-Connector Omni Spectra 21010.	Adapter-connector OS21010.
Adapter-Connector Omni Spectra 21200.	Adapter-connector OS21200.
Adapter-Connector Omni Spectra 21190 (3 required).	Adapter-connector OS21190.
Adapter-Connector Omni Spectra 21030 (3 required).	Adapter-connector OS21030.
Adapter-Connector Omni Spectra 21020 (2 required).	Acapter-connector OS21020
Adapter-Connector Omni Spectra 21170.	Adapter-connector OS21170
Adapter-Connector Omni Spectra 217.	Adapter-connector OS217
Adapter-Connector Omni Spectra 21180.	Adapter-connector OS21180
Adapter-Connector 874–QNJA (2 required).	
Adapter-Connector 874–QNJL (2 required).	
Adapter-Connector UG–636A/U.	
Adapter-Connector 874–QBJL (2 required).	
Adapter-Connector Omni Spectra 219 (2 required).	
Adapter-Connector UG–564A/U.	

c. Special Purpose Cables.

Cable Assembly, Special Purpose, Electrical SAC–SK–001.
Lead Test SAC–SK–002.
Cable Assembly, Special Purpose, Electrical SAC–SK–003.
Cable Assembly, Special Purpose, Electrical SAC–SK–004.
Cable Assembly, Special Purpose, Electrical SAC–SK–009.
Cable Assembly, Special Purpose, Electrical SAC–SK–014.
Cable Assembly, Special Purpose, Electrical SAC–SK–015.
Cable Assembly, RF CG–3573/U (4.8 in.).

*Cable Assembly, Special Purpose, Electrical CX–10762/GRC–103(V) (2 required).

*Cable Assembly, Special Purpose, Electrical Branched CX–10763/GRC–103(V)
*Cable Assembly, RF CG–3444/U (1 ft 6 in.).

*These items are part of Radio Set AN/GRC–103(V)3. They may o may not be available at this level for maintenance use.

d. Special Tools.

Clamp 702–800013
Feeler Gages, Ludell
Wrench, Torque 2/lb-in.
Inside Vernier Calipers, Mitutoyo P–52
Driftpin punch.
Special Tool SM–B–697760 (Shouldered pin)

NOTE

VSWR Detector, TRB–3 and calibrated mismatches—
TRM–1–1.00F
TRM–1–1.20F
TRM–1–1.25F
TRM–1–1.40F
TRM–1–1.50F
TRM–1–1.75F
TRM–1–2.00F
TRM–1–2.50F
are part of Test Facilities Set AN–GRM–95(V)1.

4–159. Use of Test Facilities Set AN/GRM–95(V)1—Band III Maintenance

Depot maintenance procedures for band III RF heads are based on the use of the Test Facilities Set AN/GRM–95(V)1 where possible. In conjunction with additional test equipment and/or test jigs the test facility provides, in certain cases only—

a. The necessary operating power to individual modules.

b. Internal signal sources.

c. Detection, measurement, and internal calibration facilities.

d. Cables, connectors, filters, attenuators and other equipment used in test procedures.

4-160. Amplifier-Frequency Multiplier AM–4322/GRC–103(V) (Band III Transmitter RF Head)

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Frequency Meter AN/USM–159.	Frequency meter
Wattmeter AN/URM–120	Wattmeter
Wattmeter AN/URM–98	Power meter
Multimeter, TS–352B/U	Multimeter
Voltmeter, Digital AN/GSM–64.	Digital voltmeter
Oscilloscope, AN/USM–281	Oscilloscope
Adapter-Connector Omni Spectra 21190.	Adapter-connector OS21190
Tunable Bandpass Filter, Telonic TTF 750–5–5EE.	Tunable 500–1000 MHz

b. Test Procedure.

(1) *Preliminary setup.*

(*a*) Connect the test equipment as shown in A, figure 4–313.

(*b*) Direct cooling air from the AIR OUTLET of the transmitter test facility to the rear of the unit under test.

(*c*) Set the XMTR TUNE and XMTR CHANNEL controls on the unit under test to channel 1600.

(*d*) Set the test facility switches as follows:

Switch	Switch position	Normal indications
S1	ON	
S20	S12	
S12	OSC	Test facility meter M1 indicates between 20% and 90% of full scale. LOW PWR lamp on test facility should light.
S13	ON	

(*e*) Adjust the VOLTAGE control on the

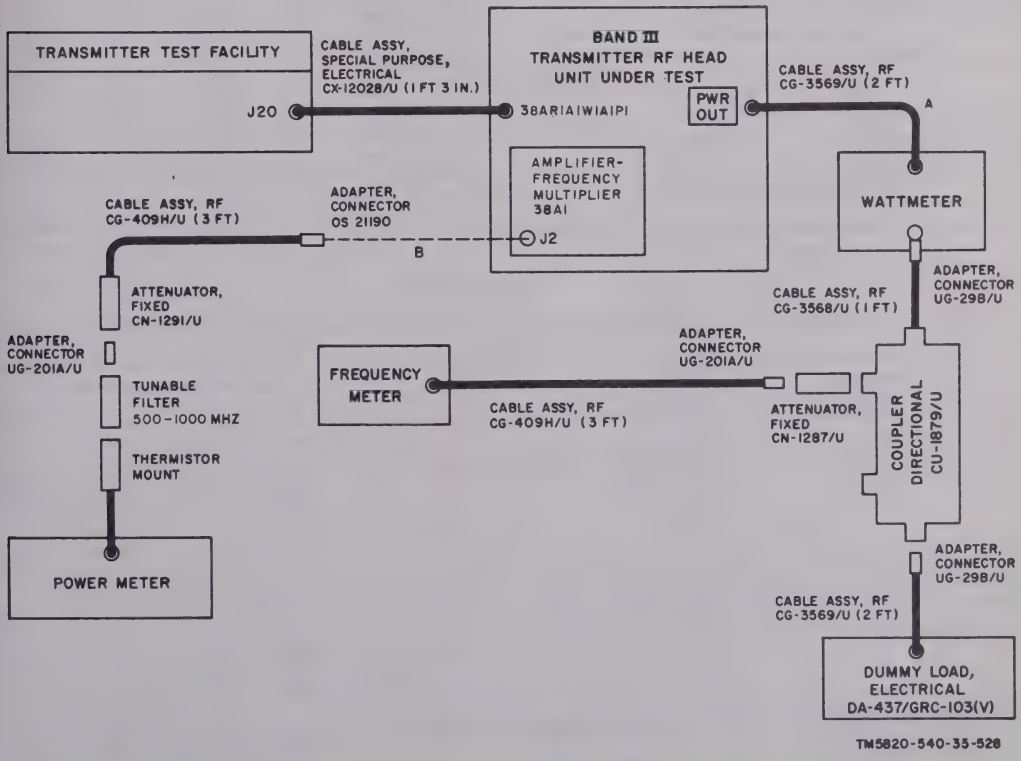


Figure 4–313. Transmitter RF head 38, test setup.

accessory kit power supply for 115v ac on the VOLTS meter.

(*f*) Turn test facility switch S12 to the following positions:

Switch position	Normal indications
DBLR	M1 indicates between 40% and 60% of full scale.
MULT	M1 indicates between 40% and 60% of full scale.
DRIVER	M1 indicates between 20% and 60% of full scale.

(*g*) Turn test facility switch S12 to PWR OUT and adjust the XMTR TUNE control on unit under test for maximum indication on meter M1. The LOW POWER lamp on the test facility should go out, the wattmeter should indicate 15 watts minimum and M1 should indicate 35 percent minimum.

(2) *Cathode and heater voltage measurement and ALC ripple check.*

(*a*) Check for the following voltages at voltage regulator assembly 38AR1A1A1 (fig. 3–62) using the digital voltmeter.

Test points	Voltage (volts dc)
TP2 (−) and TP4 (+)	6.0 to 6.4
TP1 (−) and TP3 (+)	6.0 to 6.4
TP9 (−) and TP4 (+)	15 maximum
TP9 (−) and TP8 (+)	0.65 to 0.85
TP9 (−) and TP7 (+)	0.65 to 0.85

(*b*) ALC ripple as measured on the oscilloscope connected to TP5(+) and TP9(—) of 38AR1A1A1 should not exceed 0.5v peak-to-peak.

(3) *Power output and tracking check.*

(*a*) Set the XMTR TUNE and XMTR CHANNEL controls on the unit under test to channel 990.

(*b*) Adjust the XMTR TUNE control for maximum indication on the test facility meter M1 with switch S12 at PWR OUT. The power meter should indicate at least 15 watts; the frequency meter should indicate 695 MHz + 13.9 kHz and the XMTR TUNE channel indication should be within 0.5 inch of the center of the display window.

(*c*) Repeat (*a*) and (*b*) above for the channels listed below.

Channel	Frequency (MHz)	Tolerance (± kHz)
990	695	13.9
1000	700	14.0
1080	740	14.8
1160	780	15.6
1240	820	16.4
1279	839.5	16.8
1280	840	16.8
1360	880	17.6
1440	920	18.4
1520	960	19.2
1600	1000	20.0

c. Troubleshooting (fig. 8–1).

NOTE

This chart supplements the troubleshooting procedures contained in TM 11–5820–540–12 and paragraph 3–5.

Symptom	Probable cause	Checks and corrective measures
1. DBLR meter indication zero in *b*(1)(*f*) above.	+28v interlock open circuit	Check for continuity between 38AR1A1W1A1-P1 pins 11 and 12 (fig. 3–62).
2. MULT meter indication low or zero in *b*(1)(*f*) above.	*a.* Defective frequency multiplier 38A1.	*a.* Check that at least 200 mw (+23 dbm) is present at 38A1J2 (fig. 3–60). If power level at 38A1J2 is abnormal, check that at least 2w (+33 dbm) is present at 38-AR1A1W1A1P2 (fig. 3–60). If this is normal remove 38A1 (para 4–198) and test as described in paragraph 4–161.
	b. Wiring	*b.* If input level to 38A1 is abnormal, check the continuity of cable connected to 38A1J1 (fig. 3–60). If input and output levels at 38A1 are normal, check the MULT metering circuit (fig. 8–1).
3. DRIVER meter indication low or zero in *b*(1)(*f*) above.	*a.* open circuit in driver filament line	*a.* Check resistance between 38AR1A1W1J5 (fig. 3–62) pins 11 and 12 which should be 1.5 ohms nominal. Driver tube must be inserted for this check.

Symptom	Probable cause	Checks and corrective measures
	b. Defective cable 38W1 (fig. 3–60)	*b.* Check cable with ohmmeter and replace if necessary.
	c. Defective cable 38AR1AR1W1 (fig. 3–60).	*c.* Check cable with ohmmeter and replace if necessary.
	d. Tracking misalignment between 38A1 and 38AR1.	*d.* Check tracking as described in *d* below.
	e. Excessive voltage drop across 38AR1A1FL2 (fig. 3–62).	*e.* Check voltage at E2 of 38AR1A1FL2; it should be not more than 3v lower than the voltage at E1 of 38AR1A1FL2 (630v dc nominal).
	f. Resistor assembly 38AR1A1A2 (fig. 3–60).	*f.* Disconnect wire at E1 of 38AR1A1A2. Resistance between E1 and ground should be 440K ohms.
	g. RF amplifier 38AR1	*g.* Check 38AR1 as described in paragraph 4–161.
4. PWR OUT meter indication zero in *b* (1)(*g*) above. Output power normal as indicated on wattmeter.	Metering circuit	Check PWR OUT metering circuit (fig. 8–1).
5. PWR OUT meter indication low or zero in *b* (1)(*g*) above. Output power low or zero as indicated on wattmeter.	*a.* Excessive voltage drop across 38AR1A1FL2 (fig. 3–62).	*a.* Check voltage at E2 of 38AR1A1FL2; it should be not more than 3v lower than voltage at E1 of 38AR1A1FL2. (630v dc nominal).
	b. Resistor assembly 38AR1A1A2 (fig. 3–60).	*b.* Disconnect wire at E1 of 38AR1A1A2. Resistance between E1 and ground should be 440K ohms.
	c. High insertion loss in low-pass filter 38AR1A1FL1 (fig. 3–62).	*c.* Remove 38AR1A1FL1 and test as described in paragraph 4–165.
	d. High insertion loss in circulator 38AR1HY1 (fig. 3–64).	*d.* Test circulator as described in paragraph 4–170.
6. Voltages not as specified in *b* (2)(*a*) above.	Defective voltage regulator assembly 38AR1A1A1 (fig. 3–62).	Remove voltage regulator assembly and test as described in paragraph 4–164.
7. Excessive ripple on ALC line (*b* (2)(*b*) above).	Defective voltage regulator 38AR1-A1A1.	Remove voltage regulator assembly and test as described in paragraph 4–164.
8. Incorrect frequencies	Control line(s) open circuit	Check for continuity of control lines between 38AR1A1W1J3 (fig. 3–60) and 38AR1A1-W1A1P1 (fig. 3–62).
9. Incorrect frequencies at channel 1280 and above (*b*(3)(*c*) above).	Control line 13 open circuit	Check for continuity between 38AR1A1W1A1P1 (fig. 3–62) pin 45 and 38AR1A1W1J3 (fig. 3–60) pin 13 and between 38AR1A1W1J3 pin 13 and 38AR1A1W1J2 pin 9.
10. Wattmeter or power meter indications below normal at some frequencies (*b*(3)(*b*) and (*c*) above).	Misalignment	Perform tracking alignment in *d* below.

d. Tracking Alignment.

(1) Connect the equipment as shown in B, figure 4–313.

(2) Set the XMTR TUNE and XMTR CHANNEL controls on the unit under test to channel 990 (695 MHz).

(3) Set the test facility switches S1 to ON and S12 to OSC.

(4) Set the tunable filter to 695 MHz and peak for maximum indication on the power meter. The power level at J2 of the frequency multiplier should be at least +23 dbm (+2 dbm as indicated on the power meter).

(5) If the power level is not as specified, loosen the two red-circled screws securing the idler sprocket bracket (fig. 4–314) of the frequency multiplier drive chain. Facing the front

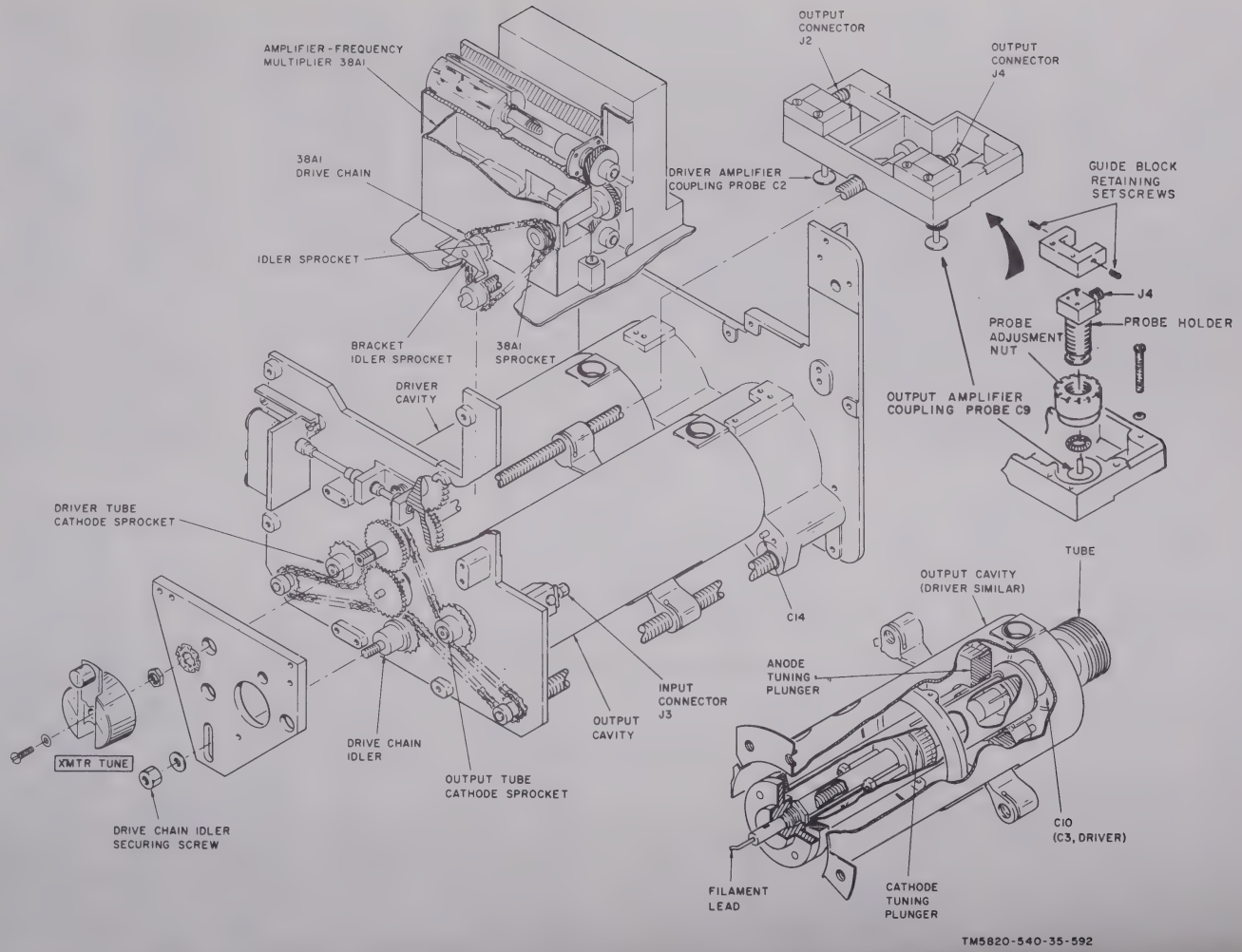


Figure 4–314. Radio frequency amplifier 37AR1, tuning mechanism and

panel of the unit, push the bracket toward the right thereby loosening the drive chain.

(6) Remove the chain from the sprocket of the frequency multiplier.

(7) Turn the sprocket of the frequency multiplier manually until the output power from the frequency multiplier reaches a maximum as indicated on the power meter.

(8) Secure the sprocket temporarily in this position with tape. Do not reconnect the chain to the sprocket of the frequency multiplier at this time.

(9) Connect P1 (38A1J2) to 38A1J2 (fig. 3–60).

(10) Connect the test equipment as shown in A, figure 4–313.

(11) Adjust the XMTR TUNE control for maximum indication on the power meter.

NOTE

Do not move the XMTR TUNE control after the RF amplifier has been peaked.

(12) Observe the XMTR TUNE display window. If necessary to position the channel frequency indicator 38AR1AR1DS1 at the correct channel number, remove the channel frequency indicator as described in paragraph 4–196.

(13) Turn the flexible shaft on the channel frequency indicator until channel number 990 is in line with the calibration mark (notch) on the body of the channel-frequency indicator.

(14) Replace the channel frequency indicator as described in paragraph 4–196.

(15) Reconnect the drive chain to the frequency multiplier sprocket and tighten the idler sprocket bracket.

(16) Check that the output power is at least 15 watts on the channels listed below:

990	1200	1400
1000	1240	1440
1040	1279	1480
1080	1280	1520
1120	1320	1560
1160	1360	1600

(17) If the power level drops, disconnect the drive chain from the frequency multiplier and repeak the frequency multiplier output by turning the frequency multiplier sprocket.

(18) Repeat steps (15) and (16) above.

4–161. Amplifier-Frequency Multiplier 38A1.

a. Test Equipment and Material Required.

Equipment	*Common name*
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Oscilloscope AN/USM–281	Oscilloscope
Frequency Meter AN/USM–159	Frequency meter
Wattmeter AN/URM–98	Power meter
Voltmeter, Digital AN/GSM–64.	Digital voltmeter
Voltmeter, Electronic ME–247 ( )/U.	RF voltmeter
Generator, Signal SG–340A/G	Signal generator
Generator, Sweep SG–888	Sweep generator
Multimeter TS–352B/U	Multimeter
Transmitter Amplifier-Frequency Multiplier Test Jig, SAC–SK–023.	Test jig
Detector, RF Telonic XD–23A	Detector XD–23A
Trombone Line, General Radio 874–LTL.	Trombone line 874–LTL
Adapter-Connector General Radio 874–QNJA (2 required)	Adapter-connector 874–QNJA
Adapter-Connector UG–107B/U.	
Adapter-Connector UG–57B/U.	
Adapter-Connector Omni Spectra 21020.	Adapter-connector OS-21020
Adapter-Connector Omni Spectra 21010.	Adapter-connector OS21010
Adapter-Connector Omni Spectra 21190.	Adapter-connector OS-21190
Adapter-Connector Omni Spectra 219 (2 required).	Adapter-connector OS-219
Cable Assy, RF, CG–3573/U (4.8 in.).	
Special Tool SM–B–697760	Shouldered pin
Alignment Gage SAC–SK–026	Alignment gage

b. Test Procedures.

(1) *Automatic level control (alc), test setup calibration.*

(*a*) Connect the test equipment as shown in figure 4–315A.

(*b*) Using the internal crystal markers adjust the SWEEP and SWEEP WIDTH controls on the sweep generator to obtain a displayed signal from 52 to 70 MHz. Set the RF ATTENUATOR to 0 db and adjust the LEVEL LIMIT and LEVEL controls to obtain a flat response at the maximum output power.

(*c*) Connect the test equipment as shown in figure 4–315B. Adjust the LEVEL control on the sweep generator to obtain a reading of +3 dbm on the power meter (+13 dbm at the output of sweep generator).

(*d*) Connect the test equipment as shown in figure 4–315C.

(*e*) Set the test facility switches S1 to ON and S12 to MULT.

(*f*) Set the sweep generator to CW and SWEEP rate to MANUAL. Manually sweep

from 52 to 70 MHz. The power should read at least +3 dbm at all frequencies (+33 dbm at RF OUT connection).

(2) *Automatic level control (alc) checks and adjustments.*

(*a*) Remove the cover plate in the amplifier-frequency multiplier 38A1A2 side of the unit under test.

(*b*) Install and secure the unit under test on the test jig, engaging the tuning drive sprocket (fig. 4–316) with the test jig drive chain.

(*c*) Connect the test equipment as shown in figure 4–317A.

(*d*) Set test jig switches S2 to ALC 1 and S3 to ON; rotate the ALC control (R1) fully CCW.

(*e*) Set the multimeter to the 2.5A DC range and the digital voltmeter to the 25V range.

(*f*) Connect the positive lead of the digital voltmeter to the junction of L4—C10 (fig. 4–318) on circuit board 38A1A2 and the negative lead to the chassis (ground) of the unit under test.

(*g*) Using crystal markers, set the sweep generator frequency to 55 MHz with the MANUAL vernier. On the test jig rotate the mechanical counter for 0000 indication.

(*h*) Digital voltmeter should read +15v ±0.1v and the multimeter indication should not exceed 1 ampere. If necessary adjust R6 on circuit board 38A1A2 to obtain +15v +0.1v.

(*i*) Connect the test equipment as shown in figure 4–317B.

(*j*) With MANUAL vernier adjust sweep generator frequency around 62.5 MHz for maximum indication on power meter.

(*k*) Adjust trombone line for minimum indication on power meter. Output from unit under test shall be +21 dbm minimum (power meter indication −2.8 dbm minimum; +21 dbm less 3 db (2:1 mismatch) less 20 db (attenuator) less 0.3 db (cable loss) and less 0.5 db (trombone line loss)).

(*l*) Adjust the ALC control on test jig for a −2.8 dbm indication on the power meter. The test facility meter M1 should indicate between 40% and 60%.

(*m*) Adjust ALC control for a −6.8 dbm indication on the power meter (output power +17 dbm). The DVM shall indicate 3v minimum.

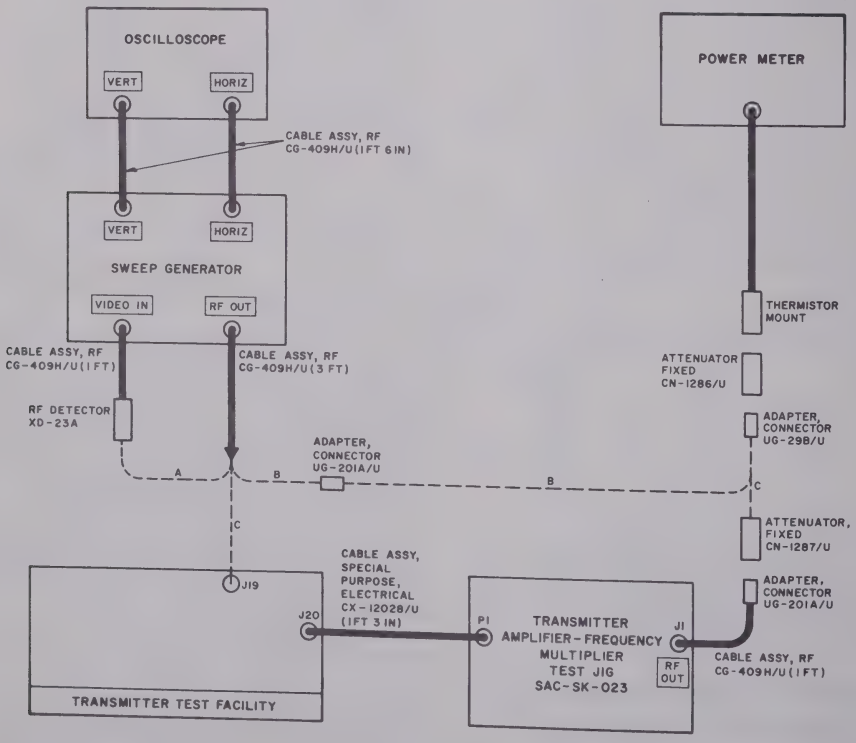


Figure 4–315. Automatic level control, test setup calibration.

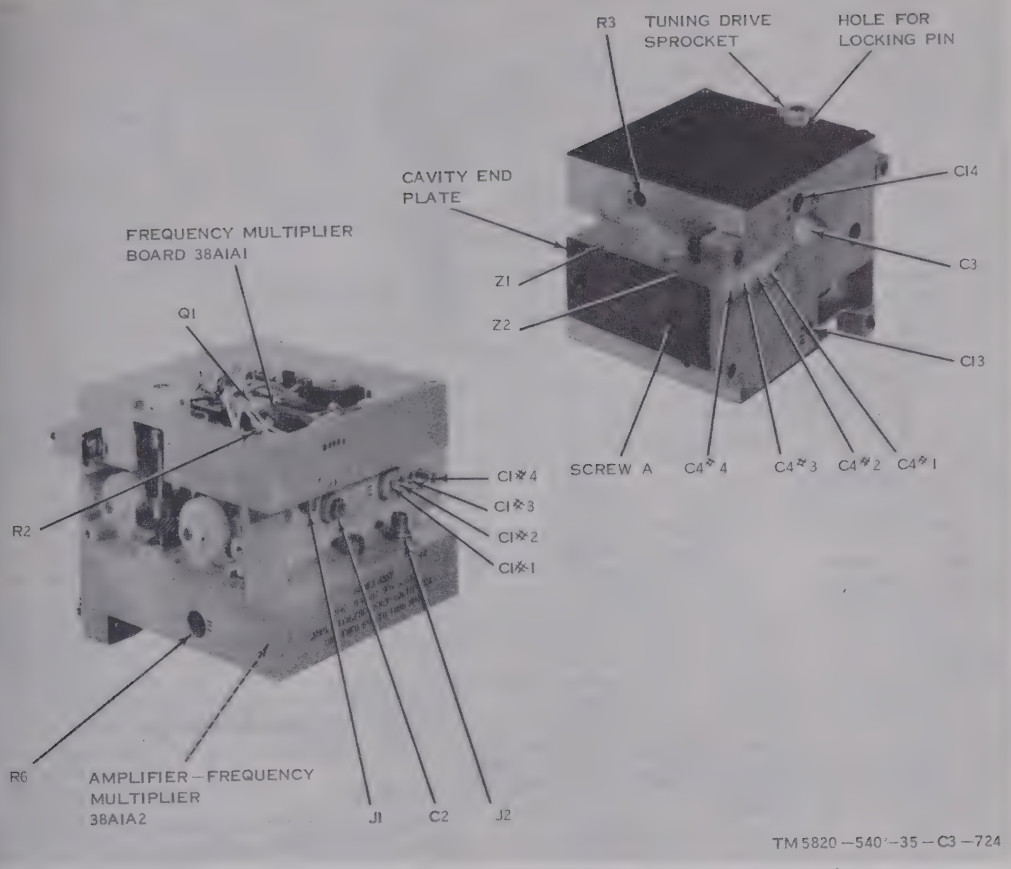


Figure 4-316. Amplifier-frequency multiplier 38A1, top and bottom views.

(*n*) Repeat steps (*d*) through (*n*) above for the frequencies and test jig counter settings listed below.

Signal generator frequency MHz	*Output frequency MHz*	*Test jig counter reading*
62.5	1000	0000
57.5	920	0040.5
52.5	840	0089.0
65.0	780	0134.5
57.92	695	0214.5

(3) *Tuning law, bandwidth and power output checks.*

(*a*) Connect the test equipment as shown in figure 4-319, with the unit under test mounted on the test jig. Disengage the unit under test tuning drive sprocket from the test jig drive chain.

(*b*) Set the coaxial switch to position 1.

(*c*) Set the test facility switches S1 to ON and S6 away from OFF.

(*d*) Set the test jig counter to 0000 and S3 to ALC ON.

(*e*) Set the signal generator frequency to 62.5 MHz and tune the unit under test for maximum output indicated on the power meter.

(*f*) Set the coaxial switch to position 2. Tune the signal generator for 1000 MHz as indicated on the frequency meter.

(*g*) Adjust the signal generator output level a +7 dbm indication on the power meter (+33 dbm into the unit under test).

(*h*) Set the coaxial switch to position 1. The power meter indication should be +5 dbm or greater (+21 dbm output from the unit under test). Note the power meter indication.

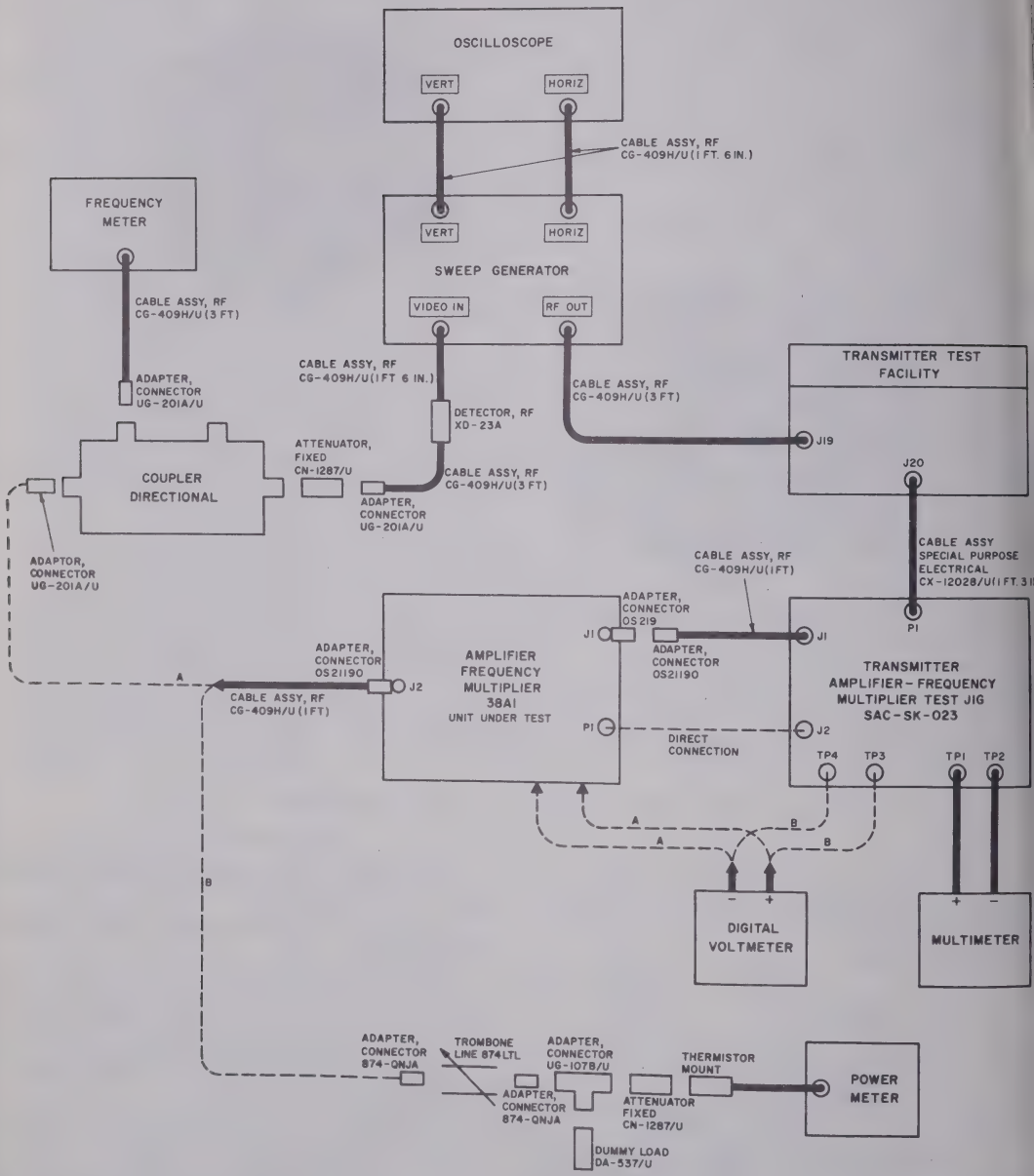


Figure 4-317. Automatic level control (alc) checks and adjustments, test setup.

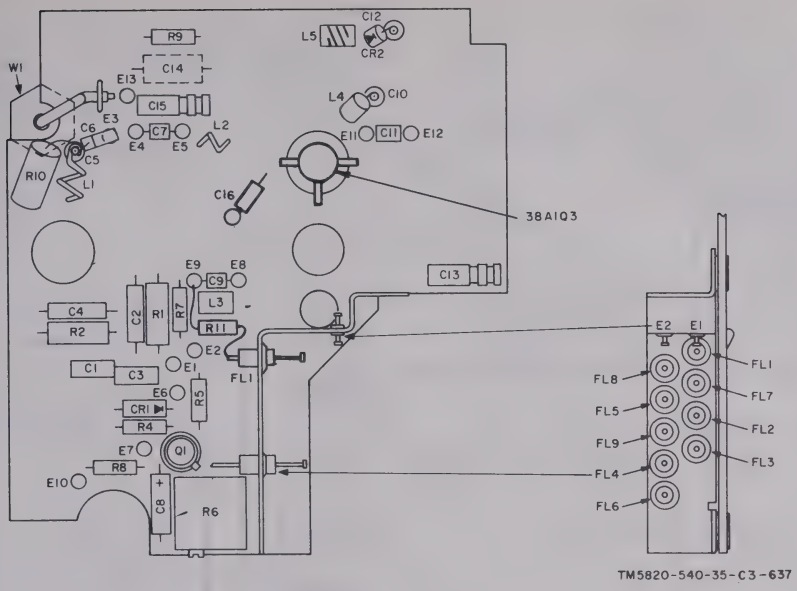


Figure 4–18. Amplifier-frequency multiplier 38A1A2, parts location.

(*i*) Increase the signal generator frequency until the power meter indication drops by 3 db.

(*j*) Set the coaxial switch to position 2 and record the frequency indicated on the frequency meter.

(*k*) Set the coaxial switch to position 1. Decrease the signal generator frequency until the power meter indication peaks, then drops again by 3 db.

(*l*) Set the coaxial switch to position 2 and record the frequency meter.

(*m*) Subtract the frequency noted in (*j*) above from that noted in (*l*) above to determine the 3 db bandwidth at 1000 MH_z. The 3 db bandwidth should be between 5 and 15 MH_z.

(*n*) Engage the tuning drive sprocket of the unit under test with the test jig drive chain taking care not to disturb the setting of the drive sprocket.

(*o*) Repeat steps (*g*) through (*n*) above for the signal generator frequencies and test jig counter settings listed below.

Test jig counter setting	*Unit under test output frequency (MHz)*	*Signal generator frequency (MHz)*
0009.5	980	61.25
0020	960	60.0
0030.5	940	58.75
0040.5	920	57.5
0051.5	900	56.25
0062.5	880	55.0
0074.5	860	53.75
0089	840	52.5
0103	820	68.34
0117	800	66.67
0134.5	780	65.0
0151.5	760	63.34
0168	740	61.67
0185.5	720	60.0
0207.5	700	58.33
0214.5	695	57.92

(4) *Input vswr check.*

(*a*) Connect the test equipment as shown in figure 4–320.

(*b*) Adjust the signal generator frequency to 62.5 MHz as indicated on the frequency meter.

(*c*) Adjust the test jig tuning mechanism until the counter reads 0000.

(*d*) Adjust the signal generator output level a power meter indication of +23 dbm (+33 dbm to the unit under test minus the directional coupler coupling factor at 125 MHz). Record the power meter indication.

(*e*) Reverse the input and output connections to the directional coupler (do not disconnect the power meter). The reflected power indicated on the power meter should be at least 9.5

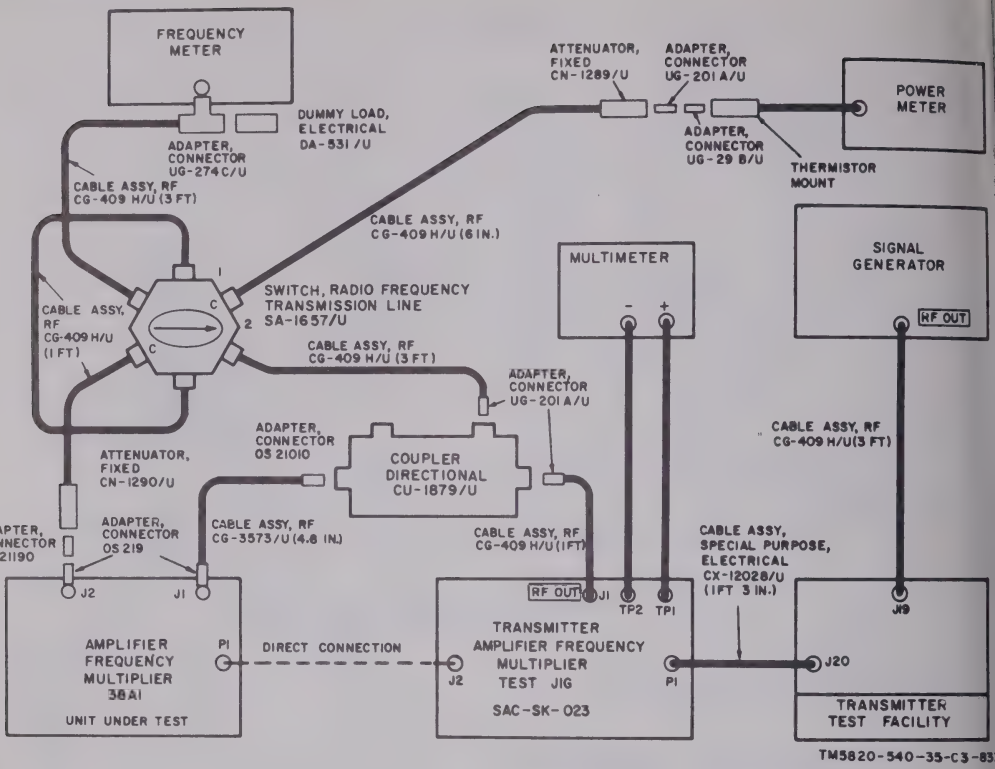


Figure 4-319. Amplifier-frequency multiplier 38A1, tuning law, bandwidth, power output, and alignment test setup.

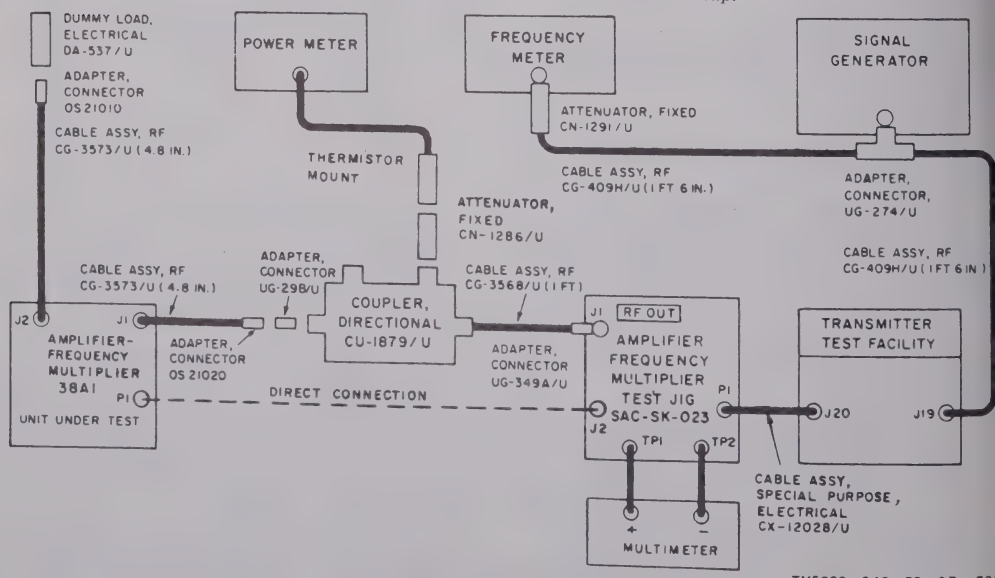


Figure 4-320. Amplifier-frequency multiplier 38A1 input vswr check, test setup.

below the level recorded in step (*d*) above. This indicates a vswr of at least 2:1.

(*f*) Repeat steps (*a*) through (*e*) above for the following frequencies and test jig counter settings:

Signal generator frequency	*Test jig counter reading*
60.0 MHz	0020.0
57.5 MHz	0040.5
52.5 MHz	0089
65.0 MHz	0134.5
57.9 MHz	0214.5

(5) *Relay check.*

(*a*) Using the test set-up as in fig. 4–317 set the test jig switch S1 to X4; the test jig 6 DB indicator lamp should light.

(*b*) Set the test jig switch S1 to X6; the test jig 12 DB indicator lamp should light.

(*c*) To remove the unit under test from the test jig set the test jig counter to 0000. Secure the unit under test tuning drive sprocket (fig. 4–316) in position, by inserting the shouldered pin through the teeth of the sprocket into the hole in the chassis. (While doing this do not rotate the sprocket by more than half a tooth).

c. Troubleshooting (fig. 8–3).

Symptom	Checks and corrective measures
1. Alc requirement not met (*b*(2)(*h*) above).	Check Q1 on 38A1A2, 38A1Q4 (fig. 4–318) and associated alc circuitry. Refer to *e.* below for voltage and resistance measurements on transistors.
2. Alc requirements not met (*b*(2)(*k*) to (*n*) above).	Check Q1 on 38A1A1 (fig. 4–321) and associated alc circuitry. Replace components as required.
3. No output indication (*b*(3)(*h*) above).	*a.* Check the RF signal path at points shown in *e*(1) below. Check dc voltages and resistances in isolated stage. *b.* Check components or cables in isolated stage. Repair or replace as required.
4. Low output power (*b*(3)(*h*) above).	*a.* Check to gain of transistor stages Q1, Q2 and Q3 on 38A. Refer to *e.* below. Check components in isolated stage *a* and replace as required. *b.* If output is low only at certain frequencies, perform alignment procedures in *d.* below.
5. High vswr)*b*(4)(*e*) above).	*a.* Check resistance of input major circuit components in Q1 (38A) base circuit from input connector J1. *b.* Check components in base circuit of alc transistor Q1 (fig. 4–32).
6. No test facility meter M1 indication (*b*(2)(*m*) above).	Check metering diode CR2 (fig. 4–32) and associated components. Replace components as required.
7. Test jig indicator lamp does not light (*b*(5)(*a*) or (*b*) above).	*a.* Check for defective relay required. *b.* Check forward and reverse resistance of diodes CR2, CR3 and CR4. Replace components as required.

d. Alignment Procedures.

(1) Prepare the unit under test as follows:

(*a*) On cavity Z2 of the unit under test, remove screw A from end plate (fig. 4–316). Turn the tuning drive sprocket counters clockwise to the stop position.

(*b*) Insert the alignment gage in place of screw A. Turn the tuning drive sprocket clockwise until the cavity plunger touches the gage.

(*c*) Insert the shouldered pin in the hole adjacent to the tuning drive sprocket (fig. 4–316) to prevent the drive gears and plungers from turning.

(*d*) Remove the gage and reinset screw A.

(*e*) Adjust C13, C1, C2, C3 and C4 (fig. 4–316) and C15 (fig. 4–321) for minimum capacities (tuning capacitors fully counterclockwise and tuning screws almost out). Adjust C14 for half capacity and L7 fully in.

(2) Mount and secure the unit under test on the test jig with the tuning drive sprocket engaged to the test jig counter drive chain.

(3) Set the counter to 0000 and remove the shouldered pin, to free the tuning drive sprocket.

(4) Connect the test equipment as shown in figure 4–322A. On the test jig operate the ALC control fully counterclockwise and set S3 to ALC ON and S2 to ALC 1.

(5) Using sweep generator internal marker frequency of 62.5 MHz, adjust screws C2 and C3 (fig. 4–316) on cavities Z1 and Z2 to obtain a response centered on 1000 MHz (Adjust the sweep width control to observe this).

(6) Adjust C14 on board 38A1A1 (fig. 4–321) and C15 on board 38A1A2 (fig. 4–318) to obtain maximum power output, then adjust C13 on board 38A1A2 until amplitude of response just ceases to increase and the response is symmetrical.

(7) Set the sweep generator to MANUAL (CW) and adjust the frequency for peak power output. Set R3 (fig. 4–321) on 38A1A1 to obtain 0.95 amperes consumption as indicated on the multimeter.

(8) Set the sweep generator to SWEEP. Set the plungers for an indication of 0040.5 on test counter. Adjust C1 No. 1 and C4 No. 1 (fig. 4–316) to obtain a symmetrical response centered on 920 MHz marker. Repeat steps (5) and (6) above using internal marker frequency of 57.5 MHz. If necessary, readjust R3 for 0.95 amperes maximum.

NOTE

Check that C4 screw does not protrude beyond mounting face.

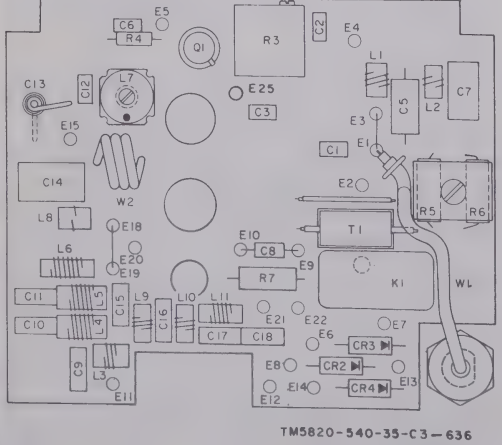
(9) Reset the plungers for an indication of 0000 on the counter and recheck the alignment at 1000 MHz. Repeat steps (5) through (8) above until the 1000 MHz and 920 MHz markers are centered on their respective responses.

(10) Adjust the plungers for an indication of 0089 on the counter and adjust C1 No. 2 and C4 No. 2 on cavities Z1 and Z2 to obtain a symmetrical response centered on 840 MHz. (This corresponds to a sweep generator marker frequency of 52.5 MHz). Current should not exceed 0.95 amperes. If necessary readjust R3.

(11) Set the sweep generator to SWEEP. Reset the plungers to 0040.5 on test jig counter. Check that response is centered at 920 MHz. Readjust C1 No. 1 and C4 No. 1 if necessary.

(12) Repeat step (10) above readjusting C1 No. 2 and C4 No. 2 if necessary, to balance frequency when tracking between 840 MHz and 920 MHz points.

(13) Once frequency tracking from 1000 MHz to 840 MHz is achieved, use L7 and C14 on 38A1A1 (fig. 4–321) to balance power output on either side of the cross-over point (i.e., both 52.5 MHz input frequency for the times-8 scale and 70 MHz for times-6 scale result in 840 MHz output frequency).



TM5820-540-35-C3—636

Figure 4–321. Frequency multiplier, 38A1A1, parts location.

(14) Set the plungers for an indication of 0134.5 on the counter. Adjust C1 No. 3 and C4 No. 3 screws to obtain a symmetrical response centered on 780 MHz (which corresponds to a marker frequency of 65 MHz). Current should not exceed 0.95 amperes. Readjust R3 if necessary.

(15) Set the plungers for an indication of 0214.5 on the counter. Adjust C1 No. 4 and C4 No. 4 screws to obtain a symmetrical response centered on 695 MHz (which corresponds to a marker frequency of 57.92 MHz). Readjust R3 if necessary for maximum consumption of 0.95 amperes.

(16) Set the plungers for an indication of 0168 on the counter (740 MHz output frequency). Using C1 No. 4 and C4 No. 4 screws, balance frequency tracking accuracy between 695 MHz and 740 MHz.

(17) Repeat steps (15) and (16) above if necessary.

NOTE

Starting point on counter indication may have to be varied by ±0010 or less; in this case steps (1) through (17) must be repeated.

(18) Set the plungers for an indication of 0000 on the test jig counter. Set the sweep generator to MANUAL (CW) and adjust the frequency around 62.5 MHz to obtain a 1000 MHz reading on the frequency meter.

(19) Connect the digital voltmeter (DVM) between the junction of L4–C10(+) on 38A1A2 (fig. 4–318) and chassis (−). Digital voltmeter should read +15v ± 0.1v. If necessary, readjust R6 for an indication of +15.0v dc ± 0.1v dc.

(20) Connect the test equipment as shown in figure 4–322B. Note output level on the power meter; the reading should be greater than +2 dbm (output power +22 dbm less 20 db (attenuator)).

NOTE

If the +2 dbm reading on the power meter cannot be obtained check the frequency tracking at this point as follows:

1. Keep the counter position fixed.
2. Manually vary the frequency control of the generator, until a peak

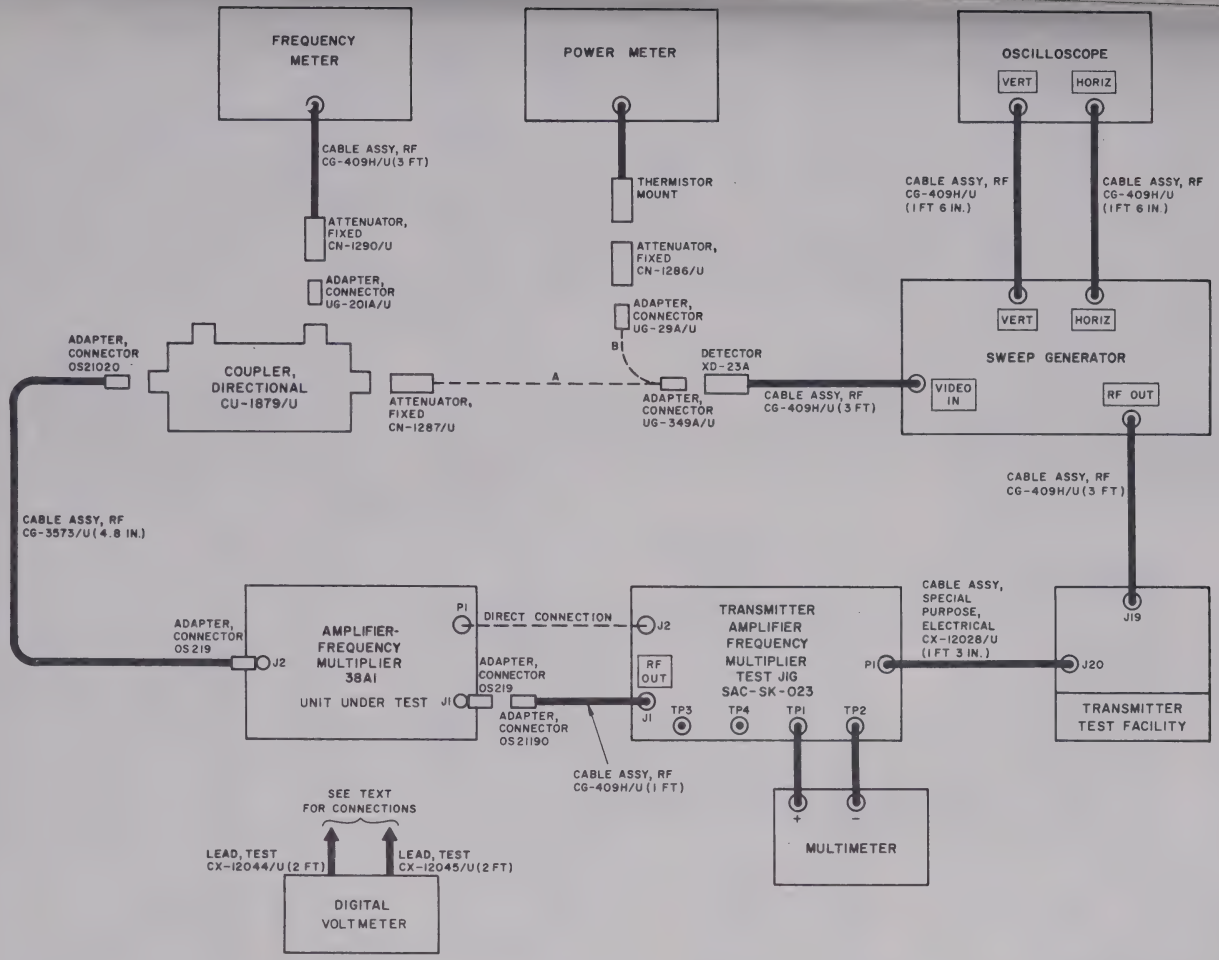


Figure 4–322. Amplifier-frequency multiplier 38A1 alignment, test setup.

power indication is obtained on the power meter.

3. If the peak power indication is appreciably higher than the one obtained at the frequent of measurement, repeat steps (11) through above to correct the tracking error at the frequency of measurement.

(21) Adjust the sweep generator MANUAL control to shift 1000 MI output frequency up to 1000.5 MHz ± 50 kHz. Note power meter reading. Repeat for 999.5 MHz ± 50 kHz. The difference between the two power meter readings give the frequency response slope at 1000 MHz. The slope must be less than 1 db/MHz.

(22) Readjust signal generator frequency for maximum indication the power meter. Increase frequency until power meter indication drops by 3 db. Note the frequency. Decrease frequency until indication peaks again then drops by 3 db from maximum. Note the frequency. The difference between the two frequencies noted above is the 3 db bandwidth at 1000 and should be 10 ± 4 MHz.

(23) Repeat steps (18) through (21) above for all frequencies listed in table below. Record the power meter readings.

INPUT FREQ MHz		OUTPUT FREQ MHz	OUTPUT POWER	COUNTER READING	ADJUSTMENT CONTROL
TEST JIG	Unit under test				
62.50	125.00	1000		0000	C2, C3
61.25	122.50	980		0009.5	
60.00	120.00	960		0020	
58.75	117.50	940		0030.5	
57.50	115.00	920		0040.5	C1 No. 1, C4 No. 1
56.25	112.50	900		0051.5	
55.00	110.00	880		0062.5	
53.75	107.50	860	+22 dbm MIN	0074.5	
52.50	105.00	840		0089	C1 No. 2, C4 No. 2
68.34	136.67	820		0103	
66.67	133.33	800		0117	
65.00	130.00	780		0134.5	C1 No. 3, C4 No. 3
63.34	126.67	760		0151.5	
61.67	123.33	740		0168	
60.00	120.00	720		0185.5	
58.33	116.67	700		0207.5	
57.92	115.83	695		0214.5	C1 No. 4, C4 No. 4

(24) Repeat step (22) above for all frequencies on table below.

INPUT MHz	OUTPUT FREQ MHz	MULTIPLIER FACTOR	COUNTER READING	POWER OUTPUT dbm MIN
62.5	1000	16	0000	21
57.5	920	16	0040.5	21
52.5	840	16	0089	21
65.0	780	12	0134.5	21
57.9	695	12	0214.5	21

e. Voltage and Resistance Measurements (fig. 8–3). All voltage measurements referenced to ground.

(1) *Voltage measurements under normal operating conditions using Voltmeter, Electronic ME–247( )/U.*

Test points	*Typical indication (volts rms)*
38A1Q1–base	3.2
–collector	33.0
38A1Q2–base	4.3
–collector	25.0
38A1Q3–base	4.2
–collector	5.1

(2) *Dc measurements referenced to ground. (Use allocated multimeter).*

Test points	*Typical indication (volts dc)*
38A1Q1–emitter	0
–base	–0.2
–collector	+24.5
38A1Q2–emitter	0
–base	–0.2
–collector	+25
38A1Q3–emmitter	0
–base	+.35
–collector	+15.0
38A1Q4–emitter	+15.0
–base	16
–collector	27.5
38A1A1Q1–base	22.0
–collector	8.4

Test points	*Typical indication (volts dc)*
38A1A2Q1–emitter	0
–base	0
–collector	+16

(3) *Transistor resistance measurements.*

NOTE

All resistances measured with Simpson 260 multimeter.

Stage	Transistor Ref	Type	Base (–) Emitter (+) Res (ohms)	Base (–) Emitter (+) Multimeter Range	Base (–) Collector (+) Res (ohms)	Base (–) Collector (+) Multimeter Range	Base (+) Emitter (–) Res (ohms)	Base (+) Emitter (–) Multimeter Range	Base (+) Collector (–) Res (ohms)	Base (+) Collector (–) Multimeter Range
38A1A1	Q1	2N2907	1000	X100	1000	X100	INF	10000	INF	X100
38A1	Q1	2N5636*	50	X1	4500	X100	13	X1	13	X1
38A1A2	Q2	2N2222A	1800	X100	11000	X10000	850	X100	800	X100
38A1	Q2	2N5636*	20	X1	4500	X100	12.5	X1	800	X100
38A1	Q3	2N4429**	100	X1	40000	X10000	15	X1	850	X100
38A1	Q4	2N3375	400000	X10000	4000	X100	850	X1	800	X100

*Modified, mounted, selected
**Modified, mounted

4–162. Control-Indicator 38A2 or 34A4

a. Test Equipment and Material Required.

Equipment	*Common name*
Test Facility, Transmitter TS–2866(V)1/GRM–95 (V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173 (V)1/GRM–95(V).	Accessory kit.
Gage, Thickness 0.003 in	Feeler gage.
Cable Assembly, Special Purpose, Electrical SAC–SK–004.	

b. Test Procedure.

(1) Connect the test equipment as shown in figure 4–323.

(2) Set test facility switches S1 and S6 to ON.

(3) Turn the tuning control shaft on the unit under test so that the numerical counter indicates channel 990.

NOTE

For control-indicator 34A4 use the first channel number in the (34A4) column in the table ((5) below).

(4) Observe the light display on the control-indicator test set. Lamps not illuminated should correspond to Xs indicated in the table below for the channel selected.

NOTE

The tape display on the control-indicator test set applies to Band I equipment only. Disregard tape display and refer to the coding table ((5) below).

(5) Repeat steps (3) and (4) above for the remaining channels listed in the table below, in the appropriate column.

Channel No. (38A2)	Lamp display coding 1	2	3	4	5	6	7	8	9	10	11	12	13	Channel No. (34A4)
990			x	x	x		x	x		x		x		930
1279		x	x	x	x				x		x	x		1219
1280					x			x		x	x		x	1220
1393	x								x	x	x		x	1333
1394		x							x	x	x		x	1334
1395	x	x							x	x	x		x	1335
1396			x						x	x	x		x	1336
1397	x		x						x	x	x		x	1337

Channel No. (38A2)	Lamp display coding													Channel No. (34A4)
	1	2	3	4	5	6	7	8	9	10	11	12	13	
1398		X	X						X	X	X		X	1338
1399	X	X	X						X	X	X		X	1339
1400				X					X	X	X		X	1340
1408					X				X	X	X		X	1348
1416				X	X				X	X	X		X	1356
1424						X			X	X	X		X	1364
1432				X		X			X	X	X		X	1372
1440					X	X			X	X	X		X	1380
1448				X	X	X			X	X	X		X	1388
1456							X		X	X	X		X	1396
1520								X	X	X	X		X	1460
	X											X	X	1589

(6) Check the stop mechanism by turning control shaft to the limit past channel 900 and channel 1699. At these points, the slipping clutch should operate to stop further movement of the gears.

CAUTION

Do not exert undue force on the mechanism if the clutch does not slip. Readjust clutch nut as described in paragraph 4–32 *d* (5).

c. Troubleshooting.

Symptom	Checks and corrective measures
1. One or more lamps, No. 2 through 13 permanently illuminated.	*a.* Remove cover of unit under test. Manually operate switch corresponding to permanently illuminated lamp; this can be done by gently pushing the ball associated with the switch (fig. 4–65).
	b. If the lamp does not extinguish while manually operating the switch, replace the faulty switch. Adjust the operating point as described in para 4–32*d*.
	c. If the lamp extinguishes, check that the ball is not sticking.
	d. Check adjustment of the switch operating point (para 4–32*d*(4)).
2. One or more lamps, No. 2 through 13 illuminated	*a.* Check for a sticking ball associated with nonoperating lamp.
	b. If lamp does not light with switch in released position, replace switch.
3. Lamp No. 13 permanently on or not illuminating	Replace command signals decoder (fig. 4–65).

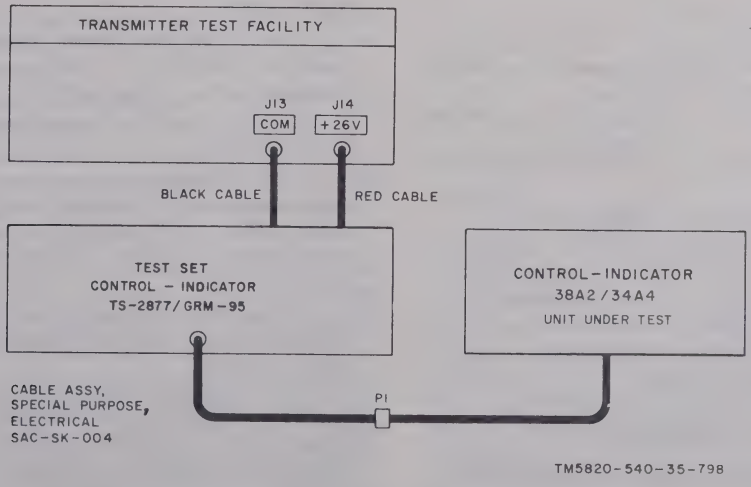


Figure 4–323. Control-indicator 38A2 or 34A4, test setup.

4–163. Radio Frequency Amplifier 38AR1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility.
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility.
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit.
Generator, Signal SG–340A/G	Signal generator No. 2.
Wattmeter AN/URM–98	Power meter.
Wattmeter AN/URM–120 with 50E plug-in element.	Wattmeter.
Oscilloscope AN/USM–140	Oscilloscope.
Generator Sweep SG–888	Sweep generator.
Frequency Meter AN/USM–159.	Frequency meter.
Drive Generator Airborne Instruments Labs Model 125.	Power signal source.
Trombone Line General Radio 874–LTL.	Trombone line 874–LTL.
Multimeter TS–352B/U	Multimeter.
Low Pass Filter, Telonic TLC–1000–5EF (2 required).	Filter TLC–1000–5EF.
Circulator Melab HD–1–450	Circulator.
Dummy Load 50 ohms, 50 watts SM–A–**697452** (3 required).	50-ohm load, 50-watt SM–A–696043.
Wideband RF Amplifier Test Jig SAC–SK–012.	Wideband RF amplifier test jig.
Adapter-Connector Omni Spectra 21190 (2 required).	Adapter-connector OS21190.
Attenuator Fixed 20 DB 50W Empire Devices, Inc. Model AT–70.	20-db 50-watt attenuator AT–70.
Adapter-Connector UG–57B/U.	
Adapter-Connector UG–107B/U.	
Adapter-Connector Omni Spectra 21170.	Adapter-connector OS21170.
Adapter-Connector Omni Spectra 21030.	Adapter-connector OS21030.
Adapter-Connector Omni Spectra 21010.	Adapter-connector OS21010.
Adapter-Connector 874–QNJA (2 required).	Adapter-connector 874–QNJA.
Dummy Load, Electrical DA–437/GRC–103(V).	
Detector, RF XD–23A	Detector XD–23A.

b. Test and Alignment Procedures.

(1) *Preliminary setup.*

WARNING

LETHAL 630V DC present at tube plate radiators.

CAUTION

Do not switch on the power signal source with its output unterminated.

(*a*) Turn power signal source output lev control to minimum.

(*b*) Remove the dust cover from the un under test and connect the test equipment a shown in A, figure 4–324.

(*c*) Direct cooling air from the AI OUTLET of the transmitter test facility, to th rear of the unit under test.

(*d*) Set the XMTR TUNE control on th unit under test to channel 1600.

(*e*) Switch on the test equipment and se the test facility switches as follows:

Switch	Position	Normal indication
S1	ON	
S16	OUTPUT NORMAL	
S20	S12	
S12	OSC	Meter M1 should indicat between 20% and 90% of full scale.

(*f*) Use multimeter to check the voltage on the voltage regulator assembly 38AR1A1A (fig. 3–62) at the test points listed below.

Test points		Voltage (dc)
Neg.	Pos.	
TP2	TP4	5.7 to 6.7
TP1	TP4	5.7 to 6.7

(2) *Output amplifier power output and inpu match checks.*

(*a*) Tune the power signal source fre quency to 1000 MHz ± 1 MHz as indicated on th frequency meter (A, fig. 4–324).

(*b*) Connect the power meter as shown i B, figure 4–324.

(*c*) Adjust the output level of the powe signal source to 2.5 watts (+34 dbm) (powe meter indication of +34 dbm, minus 20 db, minu the directional coupler coupling factor for 100 MHz).

(*d*) Set the test facility switches S13 to ON and S20 to 600V. Meter M1 should indicate withi the green band.

(*e*) Monitor the cathode voltage betwee TP4 (+) and TP9 (—) throughout testing adjust the power signal source output level a required, to maintain the cathode voltage at 14 dc ± 1v.

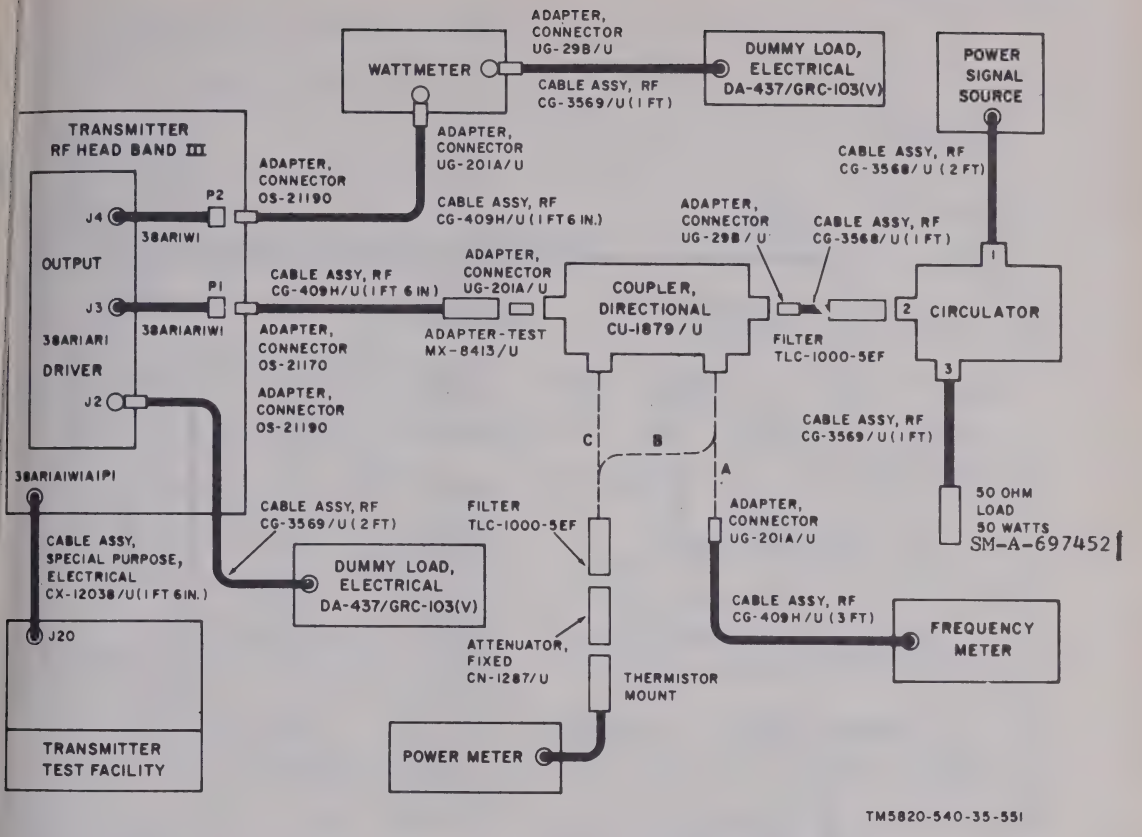


Figure 4-324. Radio frequency amplifier 38AR1 output stage, power output and input match checks, test setp.

(*f*) Set test facility switch S12 to OUTPUT CUR; meter M1 should indicate within the green band.

(*g*) Use the multimeter to check the voltage between TP8 (+) and TP9 (—). The multimeter should indicate 0.74v dc ± 0.1v.

(*h*) Adjust XMTR TUNE for a peak indication on the wattmeter. The wattmeter should indicate 30 watts or greater.

(*i*) If the output power is low, loosen the two guide block retaining setscrews on the coupling probe C9 assembly (fig. 4-314). Turn the probs adjustment nut fully counterclockwise.

(*j*) Adjust XMTR TUNE control for maximum indication on the wattmeter. Alternately rotate the probe adjustment nut (fig. 4-314) clockwise and repeak with the XMTR TUNE control until a minimum output of 30 watts is obtained. Note the wattmeter indication.

(*k*) Reset the XMTR TUNE control to indicate channnel 1600 and peak the output by adjusting trimmer capacitor 38AR1AR1C11 (fig. 3-62). The power output should be the same as that noted in (*j*) above.

(*l*) Not used.

(*m*) Check the cathode voltage as in step (*e*) above.

(*n*) Record the level indicated on the power meter (fig. 4-324); it should be +36 dbm maximum, minus 20 db, minus the directional coupler coupling factor.

(*o*) Connect the power meter to the reflected port of the directional coupler (C, fig 4-324).

(*p*) The power meter should indicate 11 db less than the level noted in (*n*) above. This is the return loss.

(*q*) If the return loss is less than 11 db proceed as follows:

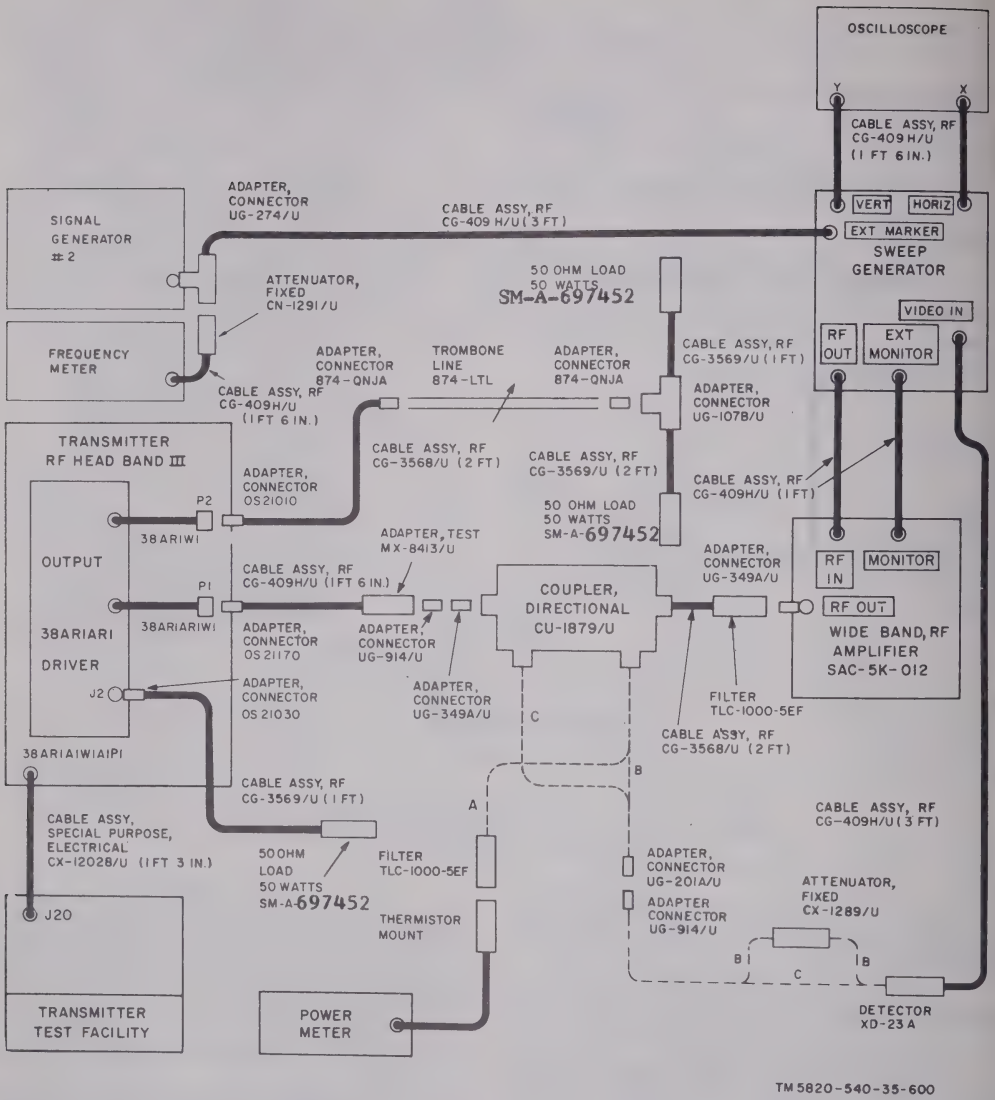


Figure 4-325. Radio frequency amplifier 38AR1, output stage stability check, test setup.

1. Remove the control panel (front panel) (para 4-195).

2. Loosen the drive chain idler (fig. 4-314) and slacken the chain.

3. Pull the chain free from the output tube cathode sprocket.

4. Rotate the freed sprocket until a minimum reflected power is obtained on the power meter.

5. Recheck the cathode voltage as in step (*e*) above.

6. Replace the chain over the sprocket and tighten the drive chain idler.

7. Recheck the return loss (steps (*n*) through (*p*) above).

8. Recheck that the power output is 30 watts minimum.

(*r*) Reduce the power signal source output level to minimum.

(3) *Output amplifier stability check.*

(*a*) Connect the test equipment as shown in A, figure 4–325.

(*b*) Set sweep generator controls to provide a maximum swept output at 1000 MHz and adjust the level control for approximately 200 mw (+23 dbm) at the output of the wideband RF amplifier test jig (power meter indication of +23 dbm minus the directional coupler coupling factor).

(*c*) Disconnect the power meter and connect the oscilloscope to the forward port of the bidirectional coupler (B, fig. 4–325).

(*d*) Set the sweep generator SWEEP WIDTH control for maximum sweep width.

(*e*) Tune signal generator No. 2 to 1010 MHz as indicated on the frequency meter. Adjust the sweep generator frequency to position the 1010-MHz marker at the extreme right of the response.

(*f*) Reduce the signal generator frequency to position the marker at the extreme left of the response. The frequency indicated on the frequency meter should be approximately 900 MHz.

(*g*) Adjust the oscilloscope control for 8 cm horizontal deflection. Mark this response on the oscilloscope graticule as the 6 db reference level (A, fig. 4–326). Tune the signal generator to 1000 MHz.

(*h*) Connect the oscilloscope to the reflected port of the bidirectional coupler (C, fig. 4–325); the waveform observed should be as shown in B, figure 4–326. Adjust the trombone line to insure that the 100-MHz marker is at the center of the tuned frequency.

(*i*) Vary the trombone line for maximum response of the waveform at the tuned frequency. The waveform at the tuned frequency should be less than the 6 db reference line.

(*j*) Rotate the XMTR TUNE clockwise and counterclockwise, and simultaneously adjust the trombone line for maximum response at the tuned frequency. Observe that the peak response remains below the reference line.

(*k*) If the peak exceeds the reference line, slightly adjust the output coupling probe C9 (fig. 4–314) to bring the response peak above the reference line.

(*l*) Not used.

(*m*) Rotate the XMTR TUNE control

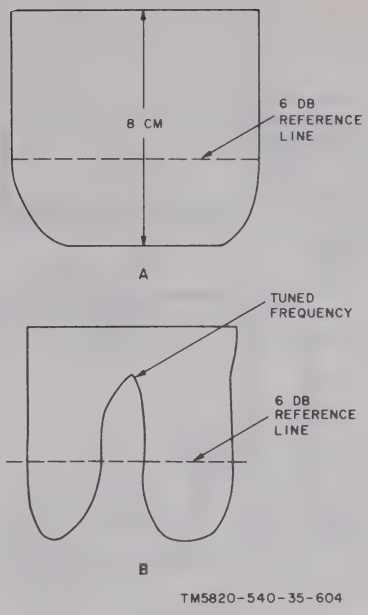


Figure 4–326. Radio frequency amplifier 38AR1 output stage stability check waveforms.

towards channel 1400 and simultaneously adjust the trombone line for maximum response amplitude. At all tuned frequencies the peak response should be less than the 6 db reference line. Repeat step (*k*) above if this requirement is not met.

(*n*) Tighten the guide block retaining setscrews in the output connector coupling probe (fig. 4–314).

(*o*) If the probe was adjusted in step (*k*) or (*m*) above, repeat the output amplifier power output and input match checks ((2) above).

(*p*) Reduce the sweep generator output level to minimum.

(4) *Driver amplifier power output and input match check.*

(*a*) Connect the test equipment to the driver amplifier as shown in A, figure 4–327. Set XMTR TUNE control to channel 1600.

(*b*) Tune the power signal source frequency to 1000 MHz ± 1 MHz as indicated on the frequency meter.

(*c*) Connect the power meter to the bidirectional coupler as shown in B, figure 4–327.

(*d*) Adjust the output level of the power signal source to 200 mw (+23 dbm) (power meter indication of +23 dbm minus the coupling factor).

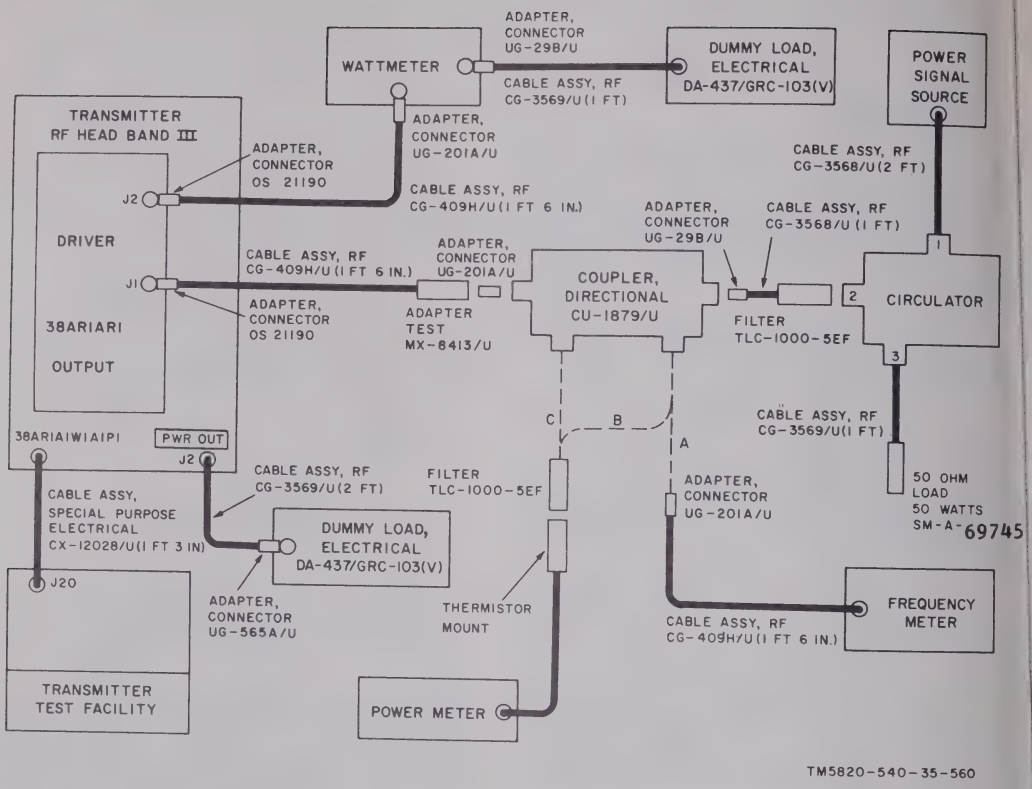


Figure 4-327. Radio frequency amplifier 38AR1 drive stage, power output and input match checks, test setp.

(*e*) Set the test facility switch S12 to DRIVER CUR; meter M1 should indicate within the green band.

(*f*) Connect the multimeter positive lead to TP7 and the negative lead to TP9. The multimeter should indicate 0.75 vdc ± 0.1v.

(*g*) The wattmeter connected to output J2 should indicate 2.5 watts or greater. If the output power is low proceed as follows:

1. Loosen the two guide block retaining setscrews on the coupling probe C2 assembly (fig. 4-314). Turn the probe adjustment nut fully counterclockwise.

2. Turn the probe adjustment nut clockwise and adjust trimmer capacitor 38AR1AR1C4 (fig. 3-62) simultaneously for a 2.5 watt ± 0.3w output power indication on the wattmeter.

(*h*) Record the level indicated on the power meter connected to the forward port of the directional coupler.

(*i*) Connect the power meter to the reflected port of the directional coupler (C, fig. 4-327). The power meter should indicate 11 db less than the level noted in (*h*) above. This is the return loss.

(*j*) If the required level in (*i*) above is not obtained, proceed as folows:

1. Remove the control panel (front panel) of the unit under test (para 4-195).

2. Loosen the drive chain idler (fig. 4-314) and slacken the chain.

3. Pull the chain free from the driver tube cathode sprocket.

4. Rotate the freed sprocket until a minimum reflected power indication is obtained on the power meter.

5. Replace the chain over the sprocket and tighten the drive chain idler.

6. Connect the power meter to the forward port of the directional coupler and repeat step (*h*) and (*i*) above.

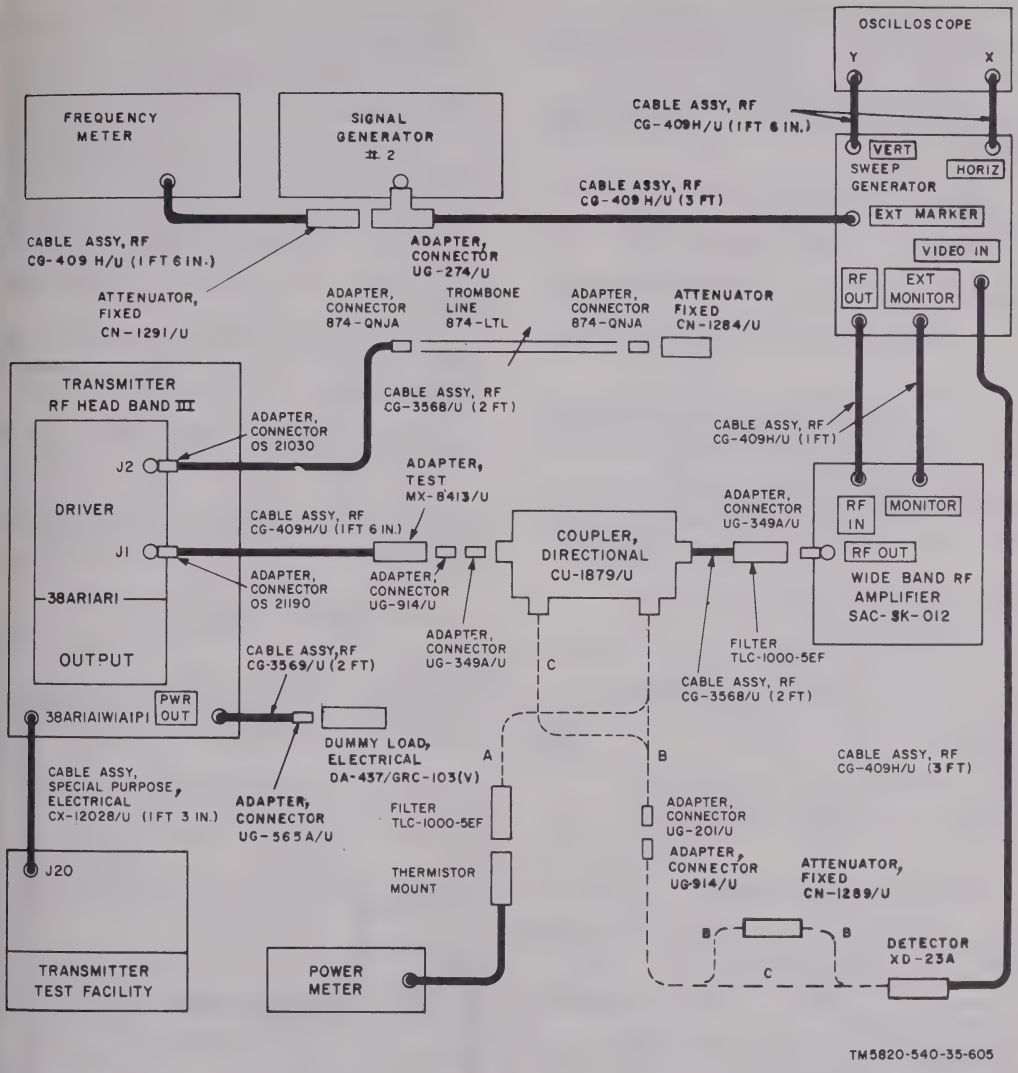


Figure 4–328. Radio frequency amplifier 38AR1 driver stage stability check, test setup.

7. Repeat step (*g*) above.

(5) *Driver amplifier stability check.*

(*a*) Connect the test equipment as shown in A, figure 4–328.

(*b*) Repeat steps (3) (*b*) through (*g*) above.

(*c*) Connect the oscilloscope to the reflected port of the bidirectional coupler (C, fig. 4–328); the waveform observed should be as shown in B, figure 4–326. Adjust the trombone line to insure that the 100-MHz marker is at the center of the tuned frequency.

(*d*) Repeat steps (3) (*i*) and (*j*) above.

(*e*) If the peak exceeds the reference line, slightly adjust the driver amplifier output coupling probe C2 (fig. 4–314).

(*f*) Rotate the XMTR TUNE control towards channel 1400 and simultaneously adjust the trombone line for maximum response ampli-

tude. At all tuned frequencies the peak response should be less than the 6 db reference line. Repeat step (*e*) above if this requirement is not met.

(*g*) Tighten the guide block retaining setscrews in the driver amplifier coupling probe (fig. 4-314).

(*h*) If the probe was adjusted in step (*e*) or (*f*) above, repeat (4) above.

(6) *Tuning and power output checks.*

(*a*) Reconnect the signal leads within the amplifier under test, to their original positions.

(*b*) Connect the test equipment as shown in A, figure 4-329.

(*c*) Check, and reset if necessary, the frequency from the power signal source; the frequency should be 1000 MHz ± 1 MHz.

(*d*) Connect the test equipment as shown in B, figure 4-329. Adjust the output level of the power signal source to +20 dbm (100 mw) (power meter indication of +20 dbm minus th coupling factor).

(*e*) Set the XMTR TUNE control t channel 1600.

(*f*) Adjust the power signal source outpu level, if necessary, to obtain 14v dc ± 1v betwee TP4 and TP9 of 38AR1A1A1. The output powe as indicated on the wattmeter should be 23 watt (+43.6 dbm) or greater. Adjust the XMTF TUNE control if necessary to peak the outpu power.

(*g*) Set the test facility switch S12 to PWR OUT. Meter M1 should indicate between 25 percent and 90 percent of full scale.

(*h*) Set S12 to REFL OUT. Meter M1 should indicate less than 10 percent of full scale.

(*i*) Disconnect the wattmeter from the PWR OUT connector. Meter M1 should indicate between 20 percent and 90 percent of full scale.

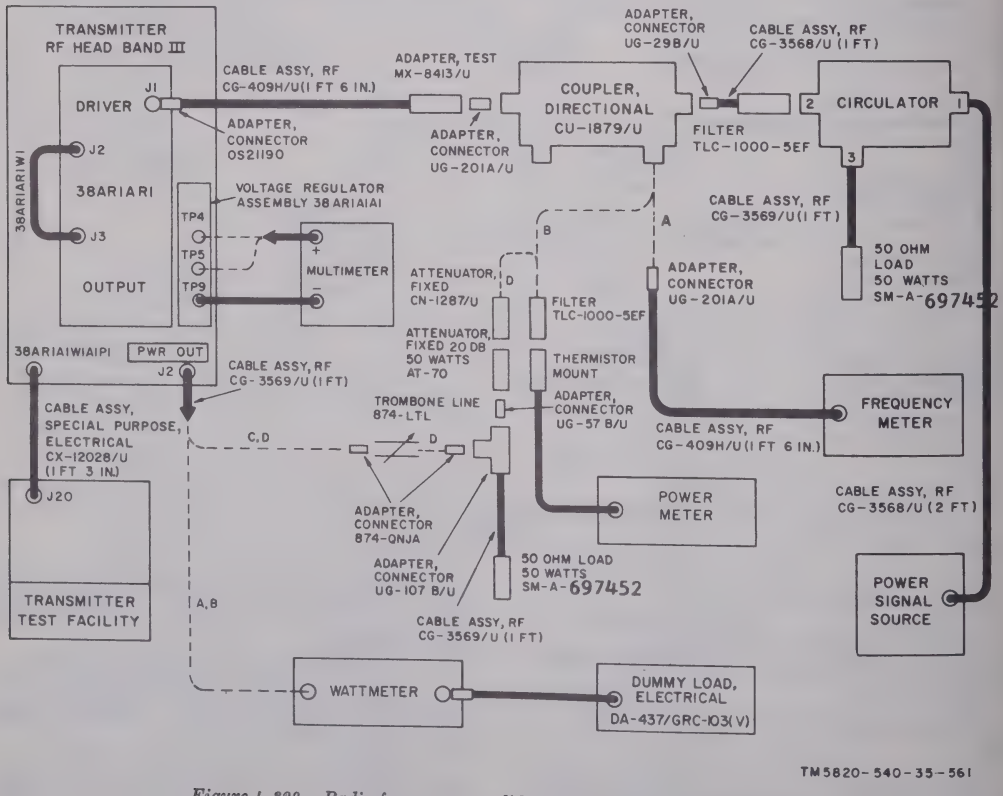


Figure 4-329. Radio frequency amplifier 38AR1, tuning, power output, alc, and vswr checks, test testup.

(*j*) Reconnect the wattmeter to the PWR UT connector and repeat steps (*e*) and (*f*) bove for the remaining channels listed below and et the power signal source to the frequency orresponding to the selected channel. Check that he required drive level does not exceed +23 dbm +3 dbm power meter indication). The output ower should be greater than 20 watts for all hannels and the tape indication shall be within ± 0.5 in. of the window centerline.

Channel	Frequency (MHz)	Typical driver power (mw)	Typical cathode voltage (vdc)	Typical output power
990	695	12	200	39
1080	740	11	200	34
1160	780	14	100	35
1240	820	13	200	34
1320	860	10	200	29
1400	900	11	200	28
1480	940	14	100	29
1540	970	14	100	28
1600	1000	14	100	25

(7) *Metering and alc checks.*

(*a*) Set the XMTR TUNE control to hannel 1600.

(*b*) Connect the frequency meter to the idirectional coupler (A, fig. 4–329) and tune the ower signal source frequency to 1000 MHz ± 1 MHz.

(*c*) Connect the multimeter (set to the 50V DC range) positive lead to TP4 and negative lead o TP9 of voltage regulator assembly 8AR1A1A1.

(*d*) Adjust the power signal source output evel for +14v dc indicated on the multimeter.

(*e*) Set the test facility switch S12 to DRIVER; meter M1 should indicate between 40 ercent and 60 percent of full scale.

(*f*) Increase the power signal source utput level for +15v dc indicated on the multi- neter.

(*g*) Connect the multimeter (set to the 10 MA DC range) TP5 (+) and TP 9 (—). The ultimeter should indicate 1 ma or greater.

(*h*) Adjust the power signal source output level for an output power of 20 watts from the unit under test, indicated on the wattmeter.

(*i*) Set the test facility switch S12 to PWR OUT. Meter M1 should indicate between 34 percent and 54 percent of full scale. Note M1 indication.

(*j*) Set S12 to REFL OUT. Meter M1 should indicate less than 10 percent of full scale.

(*k*) Disconnect cable from PWR OUT connector of assembly under test at the wattmeter. Connect the unterminated trombone line to the PWR OUT connector (C, fig. 4–329).

(*l*) Not used.

(*m*) Set the test facility switch S12 to PWR OUT. Adjust the trombone line for M1 meter indication noted in step (*i*) above.

(*n*) Set S12 to REFL OUT. Meter M1 should indicate between 58 percent and 78 percent of full scale.

(8) *Output vswr check.*

(*a*) Disconnect the trombone line and restore the test setup as shown in A, figure 4–329.

(*b*) Repeat (7) (*a*) through (*d*) above.

(*c*) Adjust the XMTR TUNE control for maximum indication on the wattmeter. If necessary, readjust the power signal source output level to maintain +14v dc multimeter indication.

(*d*) Connect the power meter and trombone line to the assembly under test as shown in D, figure 4–329.

(*e*) Adjust the trombone line for maximum power meter indication. Note this indication.

(*f*) Adjust the trombone line for minimum power meter indication. The power meter should indicate no more than 1.6 db below the value noted in (*e*) above (1.8:1 vswr).

(*g*) Repeat steps (*a*) through (*f*) above for channels 1320 and 990 with power signal source frequencies of 860 MHz and 695 MHz respectively.

(*h*) Set the test facility switch S13 to the off position.

c. Troubleshooting (figs. 2–72 and 8–1).

Symptom	Probable cause	Checks and corrective measures
Below normal or no meter M1 indication in *b*(2)(*d*) above.	*a.* Defective resistor assembly 38AR1A1A2 (fig. 3–60).	*a.* Set switches S13 and S1 on transmitter test facility to OFF. Disconnect the 600V line for E1 of resistor assembly 38AR1A1A2. Check and replace 38AR1A1A2 if shorting to ground (440 kilohms).

Symptom	Probable cause	Checks and corrective measures
	b. Defective radio interference filter 38AR1A1FL2 (fig. 3–62).	*b.* Remove the 600V line from E2 and E1 o 38AR1A1FL2. Check and replace 38AR 1A1FL2 if shorting to ground (para 4–194)
	c. 600V line shorting to ground	*c.* Check and replace 38AR1A1W1A1FL1 i shorting to ground.
	d. C3, C10 or C14 shorting to ground (fig. 4–314), or 38AR1AR1C7 (fig. 3–60).	*d.* Check C3, C10, C7 and C14 for short to ground. Replace as required.
2. Meter indication abnormal in *b*(1)(*f*) above.	*a.* Defective wiring	*a.* Check the continuity between 38AR1A1-W1A1P1 and 38AR1A1W1J5 (fig. 8–2).
	b. Defective voltage regulator assembly 38AR1A1A1 (fig. 3–62).	*b.* Test 38AR1A1A1 as described in para 4–164.
	c. Defective driver or output tube (V1, V2).	*c.* Replace V1 and/or V2 as required.
3. Power level low in *b*(2)(*h*) above	Defective output tube V2	Replace output tube.
4. Meter indication out of specified limits in *b*(4)(*e*) or (*f*) above.	*a.* Defective driver tube V1	*a.* Replace driver tube.
	b. Defective voltage regulator assembly 38AR1A1A1 (fig. 3–62).	*b.* Test 38AR1A1A1 as described in para 4–164.
5. Low output in *b*(6)(*f*) above	*a.* Defective low-pass filter 38AR1A1FL1.	*a.* Test 38AR1A1FL1 as described in para 4–165.
	b. Defective power monitor 38AR1A2.	*b.* Test 38AR1A2 as described in para 4–168.
6. Meter M1 indication out of specified limits when test facility switch S12 set to PWR OUT or REFL PWR.	Defective power monitor 38AR1A2	Test 38AR1A2 as described in para 4–168.
7. Alc voltage indication abnormal in *b*(7)(*g*) above.	Defective voltage regulator assembly 38AR1A1A1 (fig. 3–62).	Test 38AR1A1A1 as described in para 4–164.
8. Abnormal vswr indication in *b*(8)(*f*) above.	Loose or defective cable connections between stages (fig. 8–1).	Check cable connections for tightness and then check the cable connectors if necessary.

4–164. Voltage Regulator Assembly 38AR1A1A1

Voltage regulator assembly 38AR1A1A1 is identical to voltage regulator assembly 37AR1A1A1. Refer to paragrph 4–113 for tests and alignment procedures.

4–165. Low-Pass Filter 38AR1A1FL1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Generator, Sweep SG–888	Sweep generator
Generator, Signal SG–340A/G	Signal generator No. 2
Generator, Signal SG–644/U	Signal generator No. 3
Indicator, Standing Wave Ratio AN/UPM–108.	Vswr indicator
Oscilloscope AN/USM–281	Oscilloscope
Adapter-Connector Omni Spectra 21030.	Adapter-connector OS21030
Adapter-Connector Omni Spectra 21190.	Adapter-connector OS21190
Adapter-Connector Omni Spectra 21200.	Adapter-connector OS21200
RF Detector XD–23A	Detector XD–23A

b. Test Procedurss.

(1) *Vswr check.*

(*a*) Connect the test equipment as shown in A, figure 4–330.

(*b*) Adjust the sweep generator controls to obtain a sweep between 695 and 1000 MHz.

(*c*) Adjust the oscilloscope controls and the sweep generator output level control to obtain a convenient display on the oscilloscope.

(*d*) Mark the resultant display on the graticule of the oscilloscope. This display represents a vswr of 1.1.40.

(*e*) Connect the test equipment as shown in B, figure 4–330. The vswr displayed on the oscilloscope should not exceed the line marked in (*d*) above.

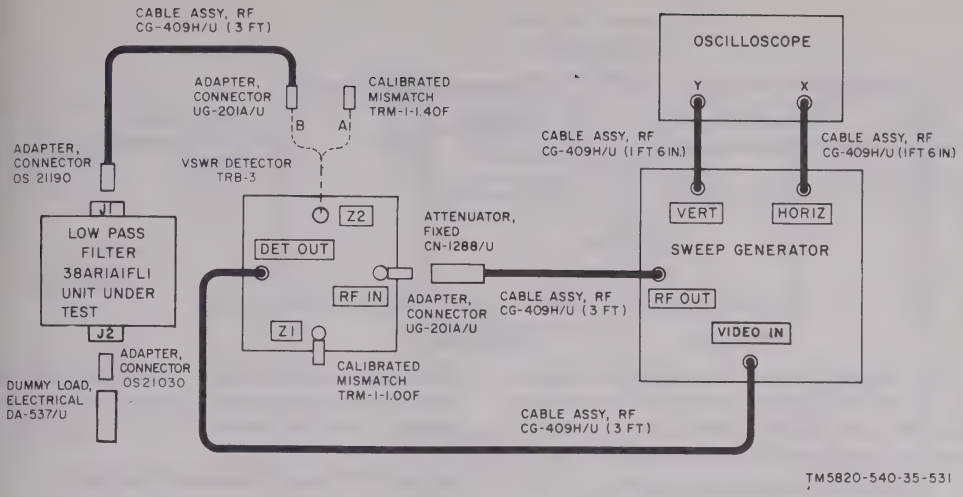


Figure 4–330. Low-pass filter 38AR1A1FL1 vswr check, test setup.

(*f*) Reverse the unit under test (i.e., connect the dummy load to J1 and connect J2 to the vswr indicator TRB–3). The vswr displayed on the oscilloscope should not exceed the line marked in (*d*) above.

(2) *Insertion loss in the passband check.*

(*a*) Connect the test equipment as shown in A, figure 4–331.

(*b*) Turn the variable attenuator to 0.

(*c*) Set signal generator No. 2 to 695 MHz with 1 kHz modulation. Adjust the level control for maximum output.

(*d*) Adjust the vswr indicator for a convenient meter indication and record the indication obtained.

(*e*) Connect the test equipment as shown in B, figure 4–331.

(*f*) Adjust the variable attenuator (0–1 db) to obtain the indication recorded in (*d*) above. The attenuator setting should not exceed 0.5 db.

(*g*) Connect the test equipment as shown in A, figure 4–331.

(*h*) Turn the variable attenuator to 0.

(*i*) Set signal generator No. 2 to 1000 MHz with 1 kHz modulation. Adjust the level control for maximum output.

(*j*) Adjust the vswr indicator for a convenient indication and record the indication obtained.

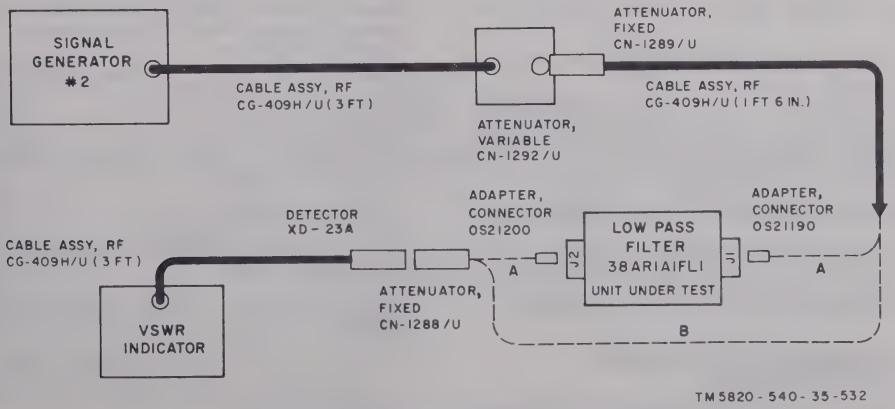


Figure 4–331. Low-pass filter 38AR1A1FL1, insertion loss check, test setup.

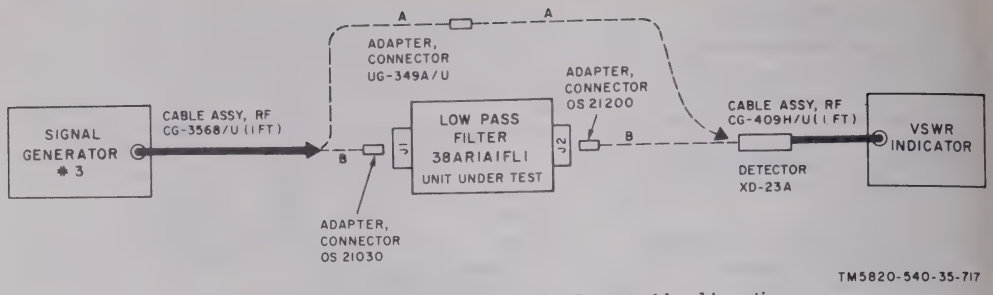


Figure 4–332. Low-pass filter 38AR1A1FL1, out-of-band insertion loss check, test setup.

(*k*) Connect the test equipment as shown in B, figure 4–331. Adjust the variable attenuator to obtain the indication recorded in (*j*) above. The attenuator setting should not exceed 0.5 db.

(3) *Out-of-band insertion loss check.*

(*a*) Connect the test equipment as shown in A, figure 4–332.

(*b*) Set signal generator No. 3 to 1390 MHz with 1 kHz modulation. Adjust output attenuator to 40 db.

(*c*) Adjust the vswr indicator for a convenient indication and record the indication obtained.

(*d*) Connect the test equipment as shown in B, figure 4–332.

(*e*) Turn the output attenuators on the signal generator No. 3 to 0. The vswr indication should be lower than recorded in (*c*) above.

(*f*) Connect the test equipment as shown in A, figure 4–332.

(*g*) Set signal generator No. 3 to 2350 MHz with 1 kHz modulation. Adjust the output attenuators to 40 db.

(*h*) Adjust the vswr indicator for a convenient indication and record the indication obtained.

(*i*) Connect the test equipment as shown in B, figure 4–332.

(*j*) Adjust the output attenuators for 0 db. The vswr indicator should indicate lower than the indication recorded in (*h*) above.

4–166. Radio Interference Filter 38AR1A1FL2

Radio interference filter 38AR1A1FL2 is identical to radio interference filter 37AR1A1FL2. Refer to paragraph 4–115 for test procedures.

4–167. Connector Filter Assembly 38AR1A1W1A1

This assembly (fig. 3–62) is tested in the same manner as connector-filter assembly 6AR1A2A3. Refer to paragraph 4–38 for test and repair procedures. Refer to figure 8–2 for wiring diagram.

4–168. RF Power Monitor 38AR1A2

RF power monitor 38AR1A2 is identical to RF power monitor 37AR1A2. Refer to paragraph 4–117 for test procedures.

4–169. Circulator 38AR1HY1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Oscilloscope AN/USM–281	Oscilloscope
Generator, Sweep SG–888	Sweep generator
Filter Low-Pass TLC–1000–5EF.	Filter TLC–1000–5EF
RF Detector XD–23A	Detector XD–23A
Adapter-Connector Omni Spectra 21030 (3 required).	Adapter-connector OS21030
Generator, Signal SG–340A/G	Signal generator No. 2
Indicator, Standing Wave Ratio AN/UPM–108.	Vswr indicator
Adapter-Connector Omni Spectra 21190 (3 required).	Adapter-connector OS21190
Dummy Load, Electrical DA–437/GRC–103(V).	

b. Test Procedure.

(1) *Vswr check.*

(*a*) Connect the test equipment as shown in A, figure 4–333.

(*b*) Set the sweep generator controls to cover the frequency range 500 to 1000 MHz.

(*c*) Adjust the oscilloscope controls and the sweep generator output level control to obtain a convenient display.

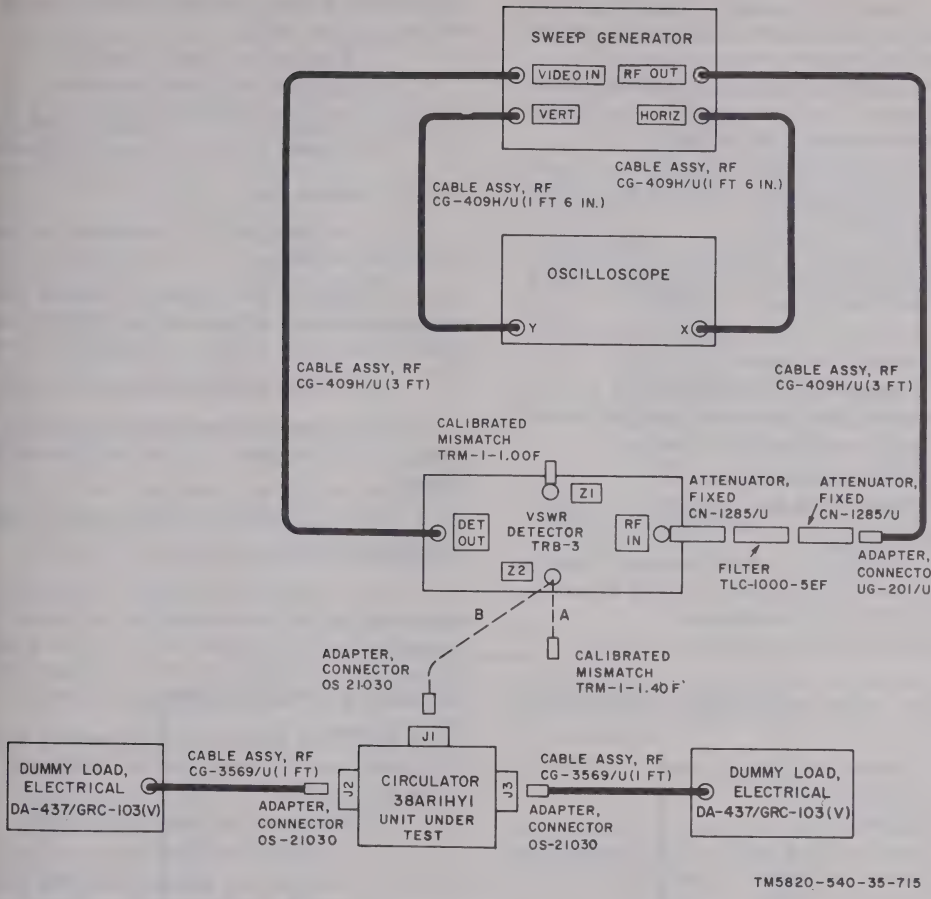


Figure 4–333. Circulator 38AR1HY1 vswr check, test setup.

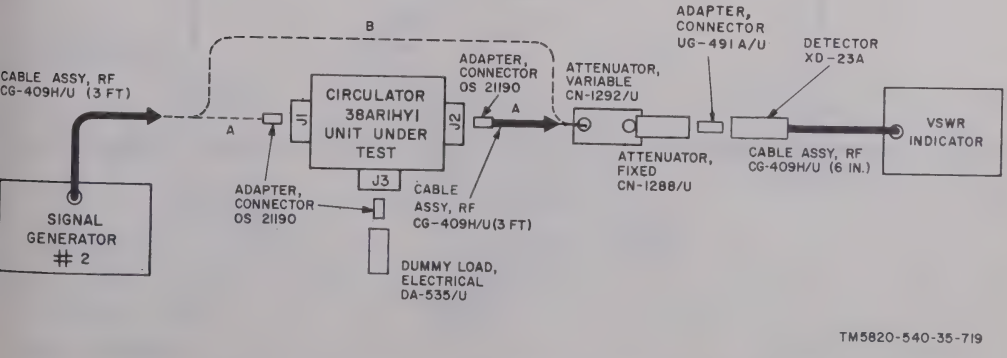


Figure 4–334. Circulator 38AR1HY1 insertion loss check, test setup.

(*d*) Mark the resultant display on the graticule of the oscilloscope. This display represents a vswr of 1:1.40.

(*e*) Connect the test equipment as shown in B, figure 4–333. The vswr displayed should not exceed the line marked in (*d*) above.

(*f*) Disconnect the dummy load (and cable) from J3 and the vswr detector from J1 of the unit under test.

(*g*) Connect tht dummy load to J1 and the vswr detector to J3. The vswr displayed should not exceed the line marked in (*d*) above.

(*h*) Disconnect the dummy load from J2 and the vswr detector from J3.

(*i*) Connect the dummy load to J3 and the vswr detector to J2. The vswr displayed should not exceed the line marked in (*d*) above.

(2) *Insertion loss check.*

(*a*) Connect the test equipment as shown in A, figure 4–334.

(*b*) Adjust the signal generator No. 2 controls to provide a frequency of 1000 MHz at a level of 0 db with 1 kHz modulation.

(*c*) Set the variable attenuator to 0 db.

(*d*) Adjust the vswr indicator controls for a convenient midscale indication. Record this reading.

(*e*) Connect the test equipment as shown in B, figure 4–334.

(*f*) Adjust the variable attenuator to obtain the indication recorded in (*d*) above. The attenuator setting should not exceed 0.6 db.

(*g*) Check the insrtion loss between J2 and J3 of the unit under test as follows (modifying test setup, B, fig. 4–334).

1. Connect the dummy load to J1.
2. Connect the signal generator to J2.
3. Connect the variable attenuator to J3.
4. Repeat steps (*c*) through (*f*) above.

(3) *Isolation test.*

(a) Connect tht test equipment as shown in A, figure 4–335.

(*b*) Adjust the signal generator No. 2 controls to provide a frequency of 1000 MHz at a level of 0 dbm with 1 kHz modulation.

(*c*) Set the variable attenuator to 0 db.

(*d*) Adjust the vswr indicator controls for a convenient midscale indication. Record this reading.

(*e*) Connect the test equipment as shown in B, figure 4–335.

(*f*) Adjust the variable attenuator to obtain the indication recorded in (*d*) above. The attenuator setting should be 9 db or greater, equivalent to isolation of 12 db or greater (3 db attenuator plus variable attenuator setting).

(*g*) Check the isolation between J1 and J3 of the unit under test as follows (modifying test setup, B, fig. 4–335):

1. Connect the dummy load to J2.
2. Connect the signal generator to J1.
3. Connect the detector XD–23A to J3.
4. Repeat steps (*c*) through (*f*) above.

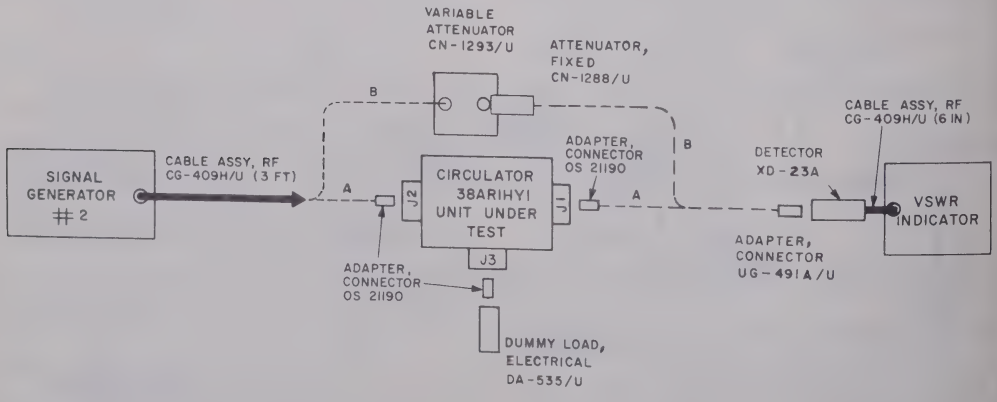


Figure 4–335. Circulator 38AR1HY1 isolation check, test setup.

4–170. Electrical Dummy Load 38AR1AT1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Oscilloscope AN/USM–281	Oscilloscope
Generator, Sweep SG–888	Sweep generator
Dummy Load Telonic TRM–1–1.30F.	Calibrated mismatch TRM–1–1.30F.
Adapter-Connector Omni Spectra 21200.	Adapter-connector OS21200

b. Test Procedure—Vswr Check.

(1) Connect the test equipment as shown in A, figure 4–336.

(2) Adjust the sweep generator controls to obtain a sweep between 695 MHz and 1000 MHz.

(3) Adjust the sweep generator controls and the oscilloscope output level control to obtain a convenient display on the oscilloscope.

(4) Mark the resultant display on the graticule of the oscilloscope as the 1:1.3 vswr calibration line.

(5) Connect the test equipment as shown in B, figure 4–336. The vswr displayed on the oscilloscope should be less than 1:1.3 (the response should not exceed the calibration line).

c. Repair of Electrical Dummy Load 38AR1AT1. If the vswr is high in the above test, check and replace R1 inside the electrical dummy load.

4–171. Amplifier-Converter AM–4318/GRC–103(V) (Band III Receiver RF Head)

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility

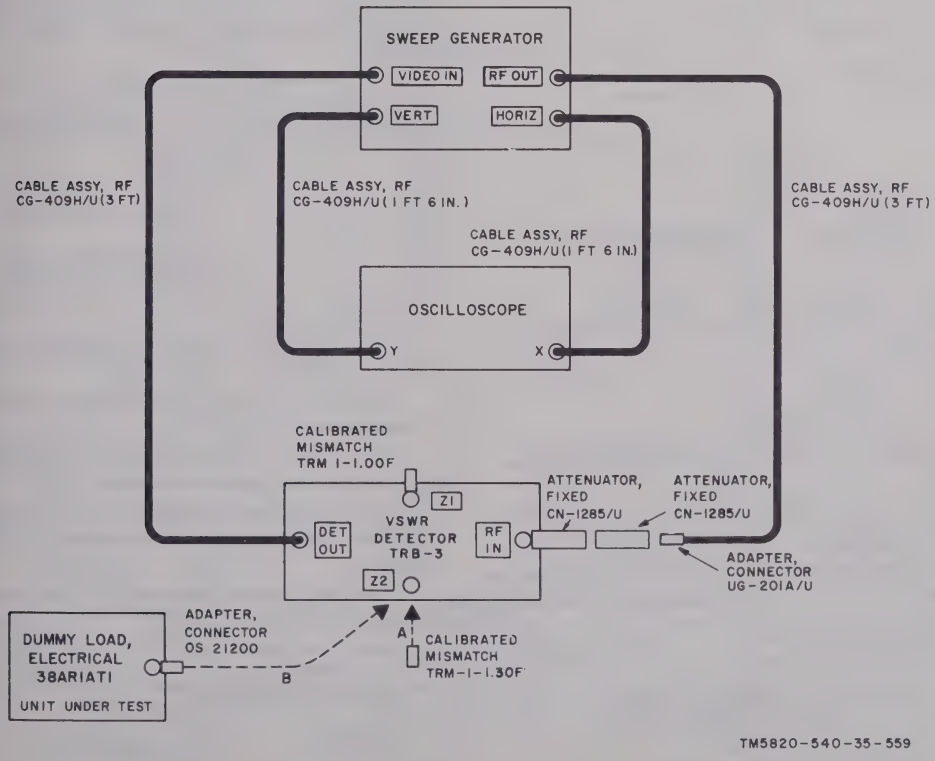


Figure 4–336. Electrical dummy load 38AR1AT1 vswr check, test setup.

Equipment	Common name
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V).	Accessory kit
Voltmeter, Electronic ME-30A/U.	VTVM
Frequency Meter AN/USM-159.	Frequency meter
Oscilloscope AN/USM-281	Oscilloscope
Generator, Sweep SG-888	Sweep generator
Wattmeter AN/URM-98	Power meter
Wattmeter AN/URM-120	Wattmeter
Voltmeter, Electronic ME-247/U.	RF voltmeter
Drive Generator, Airborne Instruments Labs Model 125.	Power signal source
Bridge, Vswr ANZAC RB-3	Vswr bridge RB-3
Generator, Signal SG-340A/G	Signal generator No. 2
Multimeter TS-352B/U	Multimeter
Noise Generator, PRD-904	Noise generator
Circulator Melab HD-1-450	Circulator
Hybrid Junction Anzac H-8	
Generator Signal AN/USM-205.	Wide range oscillator
Wide Band RF Amplifier SM-C -696030.	
Dummy Load Telonic TRM-1-3.50F.	Calibrated mismatch TRM-1-3.50F.
Adapter-Connector 874-QNJL (2 required).	
Adapter-Connector Omni Spectra OS21190.	Adapter-connector OS21190
Adapter-Connector 874-QBJL (2 required).	
Adapter-Connector Omni Spectra 21200.	Adapter-connector OS21200

b. Test Procedures.

(1) *Functional check.*

(*a*) Remove the dust cover from the unit to be tested.

(*b*) Connect the test equipment as shown in figure 4-337.

(*c*) Set the receiver test facility switches as follows:

Seitch	Position
S1	ON
S5	S6
S7	AGC
S8	OFF
S6	MULTIPLIER

(*d*) Set the unit test RCVR CHANNEL and RCVR SIG controls to channel 990 and the XMTR DUPL control at least 100 channels away from the RCVR CHANNEL setting.

(*e*) Set signal generator No. 2 to 695 MHz at an output level of —74 dbm.

(*f*) Adjust the MULT PEAK control on the unit under test for maximum indication on receiver test facility meter M1. The meter should indicate between 10 and 45 percent.

(*g*) Set the test facility switch S6 to REC SIG.

(*h*) Adjust the RCVR SIG control on the unit under test for maximum indication on test facility meter M1. The VTVM should indicate approximately —47 dbm.

(*i*) Repeat (*c*) through (*h*) above for the channels and signal generator frequencies shown in the table below.

(*j*) At channels marked with an asterisk in table below, increase signal generator No. 2 output level until the HIGH SIGNAL lamp on the receiver test facility lights. Signal generator No. 2 level should be between —10 dbm and +10 dbm as indiated on the signal generator output attenuator dial.

RCVR CHANNEL and RCVR SIG channel settings	Signal generator (receiver) frequency
990	695
*1020	710
1200	800
*1400	900
*1540	970
1600	1000

(2) *Noise figure.*

(*a*) Connect tht test equipment as shown in A, figure 4-338.

(*b*) Set the OUTPUT LEVEL control on the noise generator to OFF.

(*c*) Set the noise generator power switch to ON and set the range switch to 10.

(*d*) Set signal generator No. 2 frequency to 695 MHz and set the output attenuator dial to —60 dbm.

(*e*) Set the receiver test facility switches as follows:

Switch	Position
S1	ON
S5	S6
S6	MULTIPLIER
S7	AGC

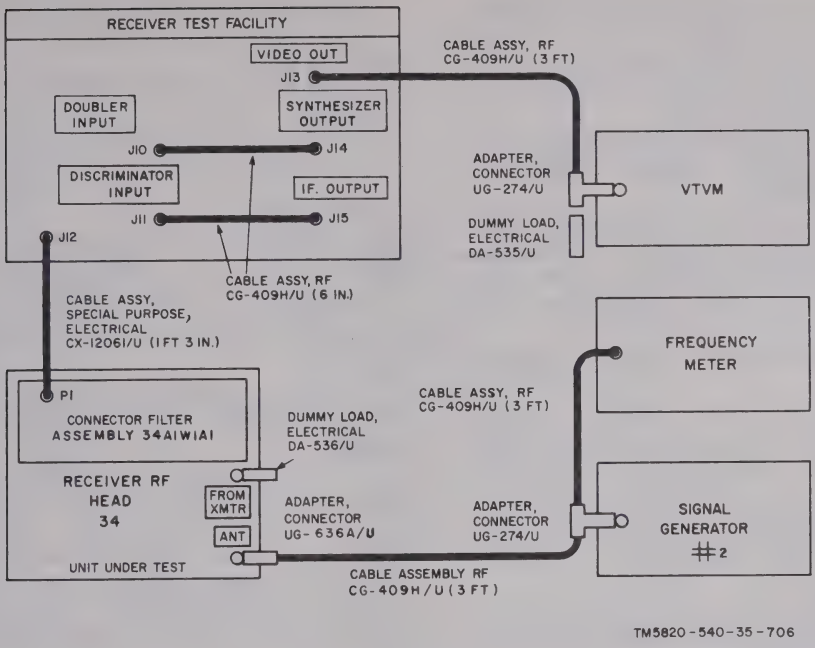


Figure 4–337. Receiver RF head, 34, functional check, test setup.

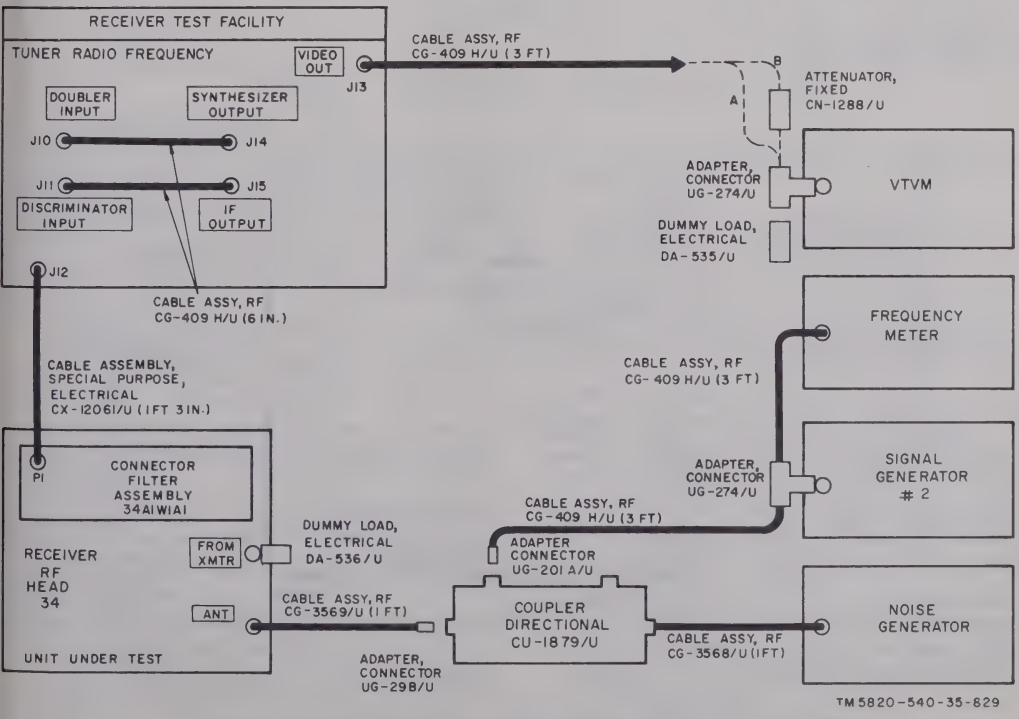


Figure 4–338. Receiver RF head, 34, noise figure check, test setup.

(*f*) On the unit under test, set the RCVR CHANNEL and RCVR SIG controls to channel 990 and the XMTR DUPL control at least 100 channels away from the RCVR CHANNEL setting.

(*g*) Adjust the MULT PEAK control on the unit under test for maximum indication on test facility meter M1.

(*h*) Set the test facility switch S6 to REC SIG and adjust the RCVR SIG control on the unit under test for maximum indication on test facility meter M1. Note the noise level indication on the VTVM (approximately —40 dbm).

(*i*) Connect the test equipment as shown in B, figure 4–338.

(*j*) Turn the noise generator OUTPUT LEVEL control to ON and adjust the OUTPUT LEVEL control to obtain the same VTVM indication as that noted in (*h*) above. The noise figure of tht unit under test is read directly from the noise generator meter scale and should not exceed 11 db.

(*k*) Repeat (*a*) through (*j*) above for the equipment settings marked with an asterisk in the table in (1)(*j*) above.

(3) *Receiver protection circuit check.*

(*a*) Connect the test equipment as shown in figure 4–339.

(*b*) Set the receiver test facility switches as follows:

Switch	Position
S1	ON
S5	S6
S6	REFL PWR
S7	AGC

(*c*) Set the RCVR CHANNEL and RCVR SIG controls on the receiver RF head to channel 990.

(*d*) Set the XMTR DUPL control at least 100 channels away from the RCVR CHANNEL setting.

(*e*) Set the power signal source frequency to 695 MHz and set the output level to minimum

(*f*) Slowly increase the power signal source output level to 35 watts while observing the power meter indication and the HIGH SIGNAL alarm lamp on the test facility. The power level at J2 (34A5) should not exceed +17 dbm (+7 dbm indication on the power meter),

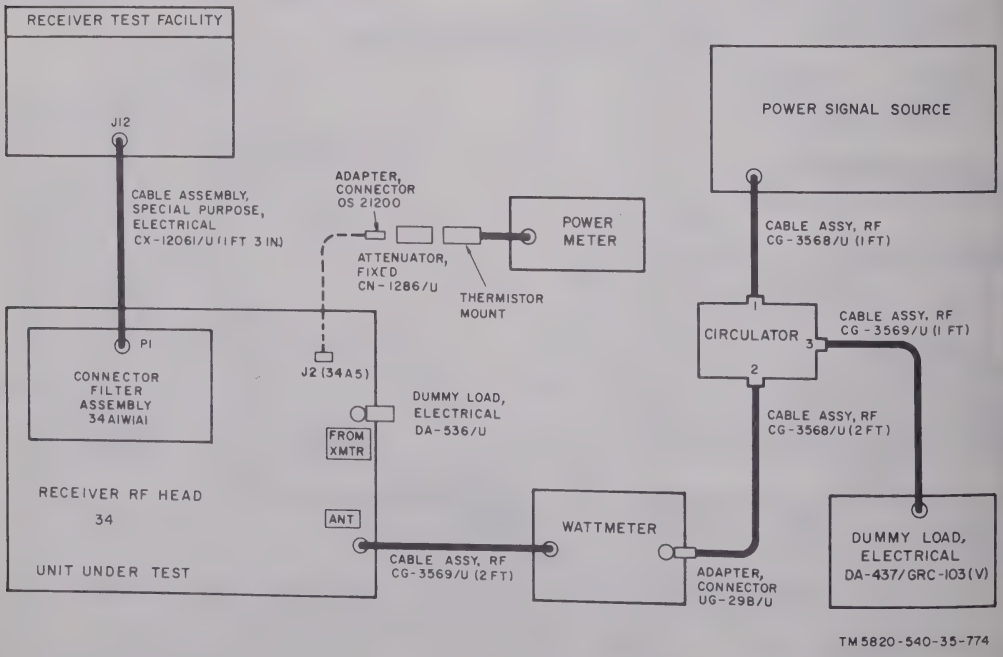


Figure 4–339. Receiver RF head, 34, receiver protection circuit check, test setup.

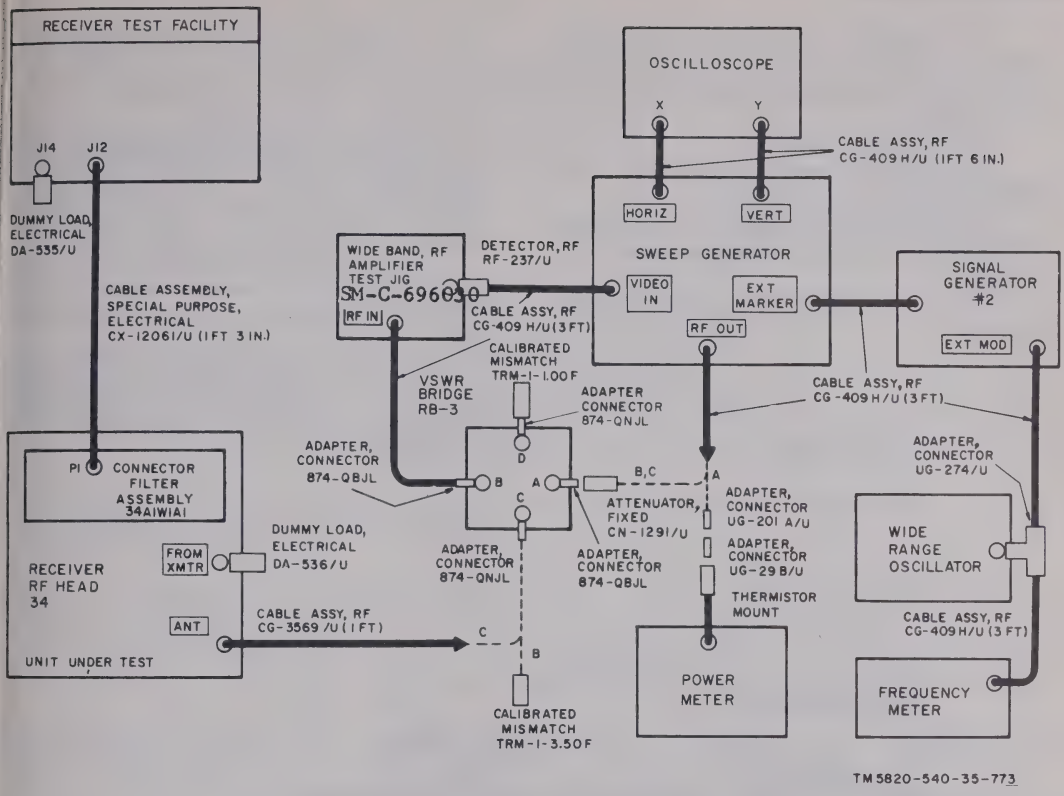


Figure 4–340. Receiver RF head, 34, input vswr check, test setup.

the HIGH SIGNAL alarm lamp on the test facility should light and test facility meter M1 should indicate between 80 and 100 percent of full scale deflection.

(*g*) Repeat (*c*) through (*f*) above for the equipment settings marked with an asterisk in the table in (1) (*j*) above.

(4) *Input vswr check.*

(*a*) Connect the equipment as shown in A, figure 4–340.

(*b*) Set the sweep generator center frequency to 695 MHz with a sweep width of approximately 10 MHz.

(*c*) Adjust the sweep generator output level for 0 dbm as indicated on the power meter.

(*d*) Connect the equipment as shown in B, figure 4–340.

(*e*) Calibrate the oscilloscope for a vswr of 3.5:1 between 695 and 1000 MHz.

(*f*) Reset the sweep generator center frequency to 695 MHz.

(*g*) Connect the equipment as shown in C, figure 4–340.

(*h*) Set the RCVR SIG and RCVR CHANNEL controls on the unit under test to channel 690 and set the XMTR DUPL control at least 100 channels away from the RCVR CHANNEL setting. The vswr at the peak of the response curve, as displayed on the oscilloscope, should not exceed the 3.5:1 vswr calibration mark.

(*i*) Set signal generator No. 2 to 695 MHz.

(*j*) Adjust the wide range oscillator (wro) frequency and fine tune signal generator No. 2 to place markers at the point where the response curve intersects the 3.5:1 vswr calibration line. Note the wro frequency indicated on the frequency meter.

(*k*) Multiply the wro frequency noted in (*j*) above, by 2 to obtain the bandwidth. The bandwidth should be greater than 3.0 MHz.

(*l*) Not used.

(*m*) Repeat (*f*) through (*k*) above for RCVR SIG, RCVR CHANNEL settings, and signal generator frequencies listed in the table in (1) (*j*) above.

(5) *AGC check.*

(*a*) Connect the test equipment as shown in figure 4–341.

(*b*) Set signal generator No. 2 frequency to 900 MHz and set the output attenuator dial to —90 dbm.

(*c*) Set the receiver test facility switches as follows:

Switch	Position
S1	ON
S5	S6
S6	MULTIPLIER
S7	AGC

(*d*) Set the RCVR CHANNEL and RCVR SIG controls on the unit under test to channel 1400 and adjust the MULT PEAK control for maximum indication on test facility meter M1.

(*e*) Adjust the RCVR SIG control for maximum indication on the RF voltmeter which should be approximately —40 dbm. Note the indication.

(*f*) Set signal generator No. 2 output attenuator to —50 dbm. The RF voltmeter should indicate not more than 7 db above the level noted in (*e*) above.

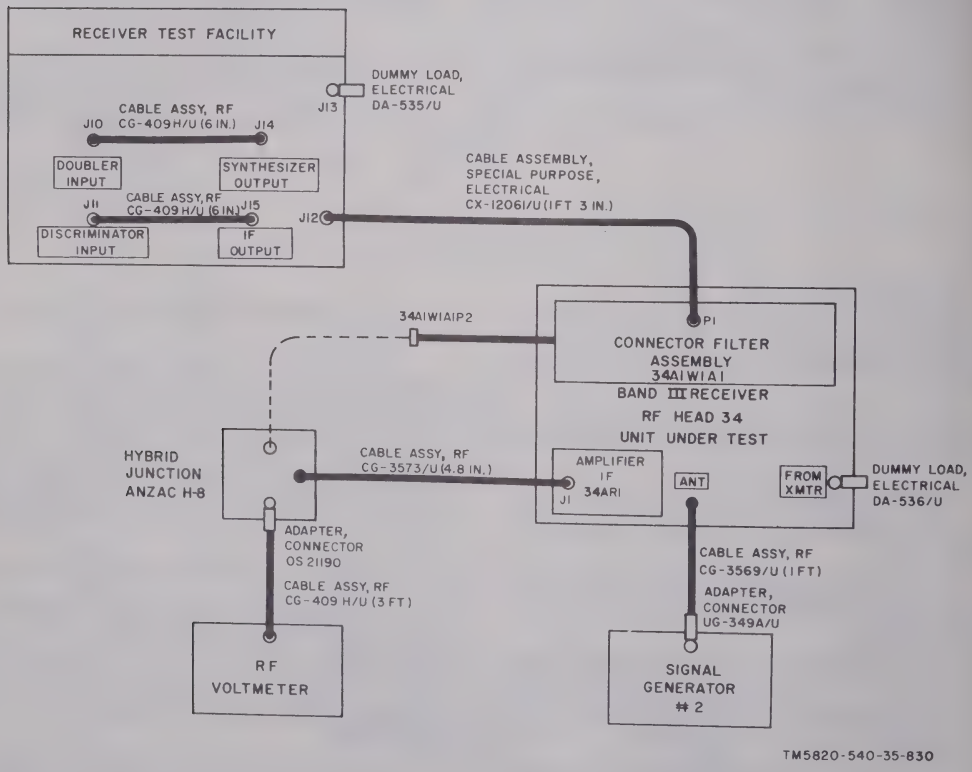


Figure 4–341. Receiver RF head, 34, AGC check, test setup.

c. Troubleshooting (fig. 8-8).

Symptom	Probable cause	Checks and corrective measures
Test facility meter M1 indication (MULTIPLIER) below normal (*b*(1)(*f*) above).	*a.* Defective control indicator 34A4 (fig. 3-69).	*a.* Test as described in para 4-182.
	b. Defective wiring	*b.* Check continuity of metering circuit between pin 4 of 34A1W1J8 (fig. 3-76) and pin 24 of 38A1W1A1P1 (fig. 3-69). Check the continuity between 34A1W1J5 and 34A1W1A1P1.
	c. Defective frequency mixer stage 34A7 (fig. 3-76).	*c.* Check metering circuit of 34A7 as described in para 4-185.
High signal alarm operates outside specified limits (*b*(1)(*j*) above).	Defective signal level control-monitor 34A5 (fig. 3-69).	Test as described in para 4-183.
Noise figure exceeds 11.0 db at one or more frequencies (*b*(2)(*j*) and (*k*) above).	*a.* Defective frequency mixer stage 34A7 (fig. 3-76).	*a.* Test as described in para 4-185.
	b. Defective IF amplifier 34AR1 (fig. 3-76).	*b.* Test as described in para 4-186.
VTVM indication exceeds +7 dbm calibration level at one or more frequencies (*b*(3)(*f*) and (*g*) above).	Defective signal level control-monitor 34A5 (fig. 3-69).	Test as described in para 4-183.
Indication on test facility meter M1 low or zero when S6 at REFL PWR position (*b*(3)(*f*) and (*g*) above).	*a.* Defective wiring	*a.* Check the continuity from pin 1 of 34A1W1J3 (fig. 4-341) to pin 25 of 34A1W1A1P1 (fig. 3-69) and from pin 3 of 34A1W1J3 to pin 26 of 34A1W1A1P1.
	b. Defective RF power monitor (fig. 4-342).	*b.* Replace 34A3 as described in para 4-181.
Input vswr exceeds 3.5 at one or more frequencies (*b*(4)(*k*) above).	*a.* Defective duplexer subassembly 34A1A1 (fig. 3-76).	*a.* Check output vswr at J1 of impedance matching network 34A1A1Z1 (para 4-173(2)).
	b. Damaged connectors	*b.* If above vswr check is normal, check that connectors from ANT to the impedance matching network 34A1A1Z1 are not damaged.
	c. Defective power monitor 34A3	*c.* If connectors are undamaged replace power monitor 34A3 as described in para 4-203.
Bandwidth less than 3 MHz at one or more frequencies (*b*(4)(*k*) above).	Defective duplexer subassembly 34A1A1 (fig. 3-76).	Test 34A1A1 as described in para 4-173.
AGC action not as specified (*b*(5)(*f*) above).	Defective IF amplifier 34AR1 (fig. 3-76).	Test IF amplifier as described in para 4-186.

d. Alignment Procedure.

(1) *Local oscillator.*

(*a*) Connect the test equipment as shown in A, figure 4-343.

(*b*) Set the receiver test facility switches as follows:

Switch	Position
S1	ON
S5	S6
S6	MULTIPLIER
S7	AGC

(*c*) Set the RCVR CHANNEL and RCVR SIG controls on the unit under test to channel 1300 and set the XMTR DUPL control at least 100 channels away from the RCVR CHANNEL setting.

NOTE

Do not allow the duplexer gears to move while adjusting the multiplier group gears.

(*d*) Loosen the clamp of gear A (fig. 3-73) and rotate the gear for maximum indication on test facility meter M1.

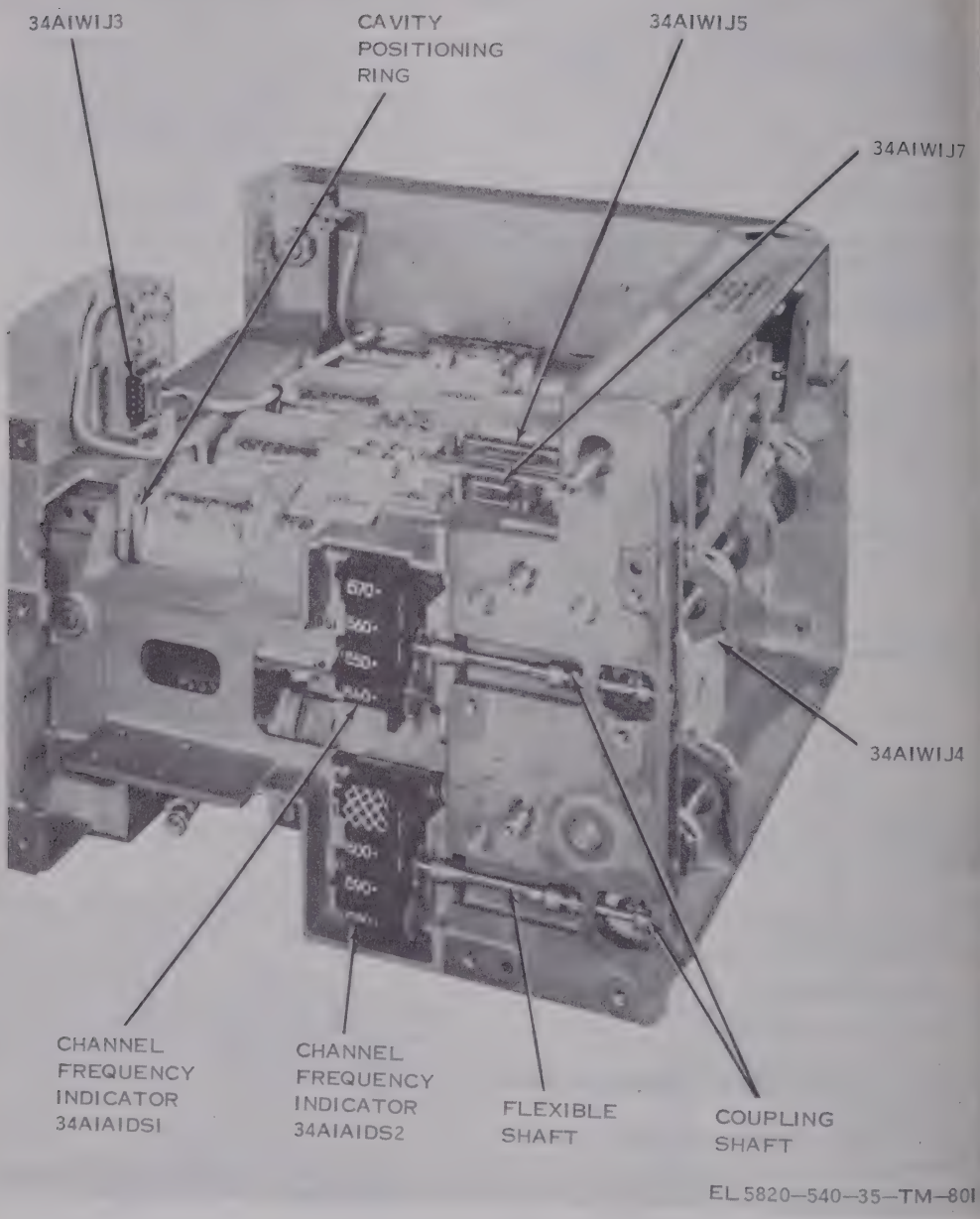


Figure 4-342. *Receiver RF head, 34, front view, front panel removed.*

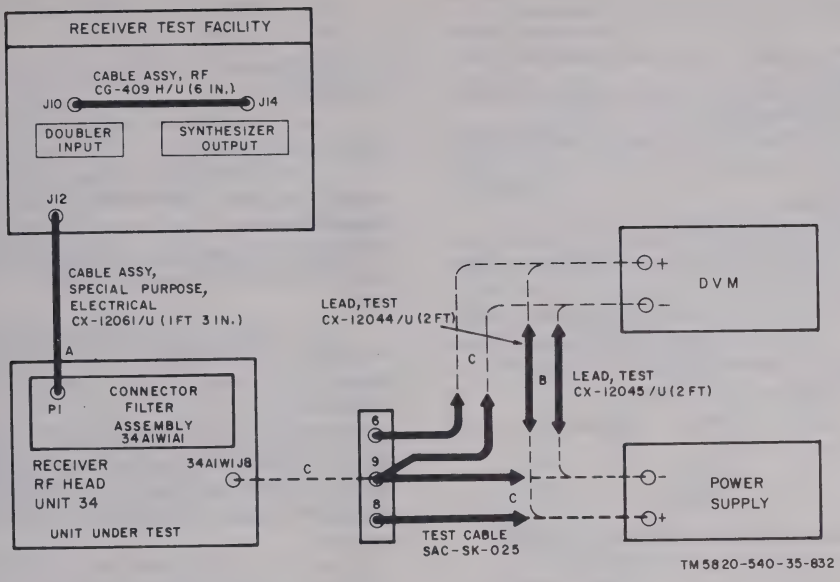


Figure 4–343. Receiver RF head, 34, alignment, test setup.

(*e*) Tighten the clamp of gear A while ensuring that meter M1 indication remains at maximum.

(*f*) Set test facility switch S1 to OFF.

(*g*) Set the power supply voltage control fully counterclockwise and set the current limiter control to 0.3A.

(*h*) Connect the test equipment as shown in B, figure 4–343.

(*i*) Adjust the power supply output voltage to 57.4 volts.

(*j*) Remove frequency mixer stage 34A7 (fig. 3–76) and connect the test equipment as shown in C, figure 4–343.

(*k*) Set test facility switch S1 to ON.

(*l*) Not used.

(*m*) Loosen the clamp of gear B (fig. 3–73) and rotate the gear for an indication of 13.3 volts on the DVM.

(*n*) Tighten the clamp of gear B while ensuring that the DVM indication remains at 13.3 volts.

(*o*) Repeat functional check in *b* (1) above.

4–172. Duplexer 34A1

This assembly comprises duplexer subassembly 34A1A1 (para 4–173), voltage control assembly 34A1A2 (para 4–209), speed decreaser gear assembly 34A1MP1 (para 4–205), and branched wiring harness 34A1W1 (fig. 8–7). There is no overall test for the duplexer. Refer to the appropriate paragraphs or figures for testing and/or replacement procedures for the individual units which make up the duplexer.

4–173. Duplexer Subassembly 34A1A1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility.
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Generator, Sweep SG–888	Sweep generator
Oscilloscope AN/USM–281	Oscilloscope
Generator, Signal SG–340A/G	Signal generator No. 2
Generator, Signal AN/USM–205.	Wide range oscillator
Frequency Meter AN/USM–159.	Frequency meter
Detector, RF XD–23A	Detector XD–23A
Low-Pass Filter TLC–1000–5EF.	Filter TLC–1000–5EF
50-ohm load Omni Spectra 20020P (2 required).	50-ohm load OS20020P

Equipment	Common name
Adapter-Connector Omni Spectra 21020.	Adapter-connector OS21020
Adapter-Connector Omni Spectra 21190 (2 required).	Adapter-connector OS21190
Adapter-Connector Omni Spectra 217.	Adapter-connector OS217

b. Test Procedures.

(1) *Preliminary setup.*

(*a*) Connect the test equipment as shown in A, figure 4–344.

(*b*) Turn the sweep generator output attenuator to 0 db and sweep width to maximum. Ensure that the sweep generator output is level from at least 695 to 1000 MHz.

(*c*) Mark the 2.0:1 vswr response on the oscilloscope graticule.

NOTE

Do not readjust the oscilloscope vertical gain or positioning controls during the following tests.

(2) *Transmitter filter vswr, bandwidth an backlash.*

(*a*) Connect the test equipment as show in B, figure 4–344.

(*b*) Adjust the signal generator No. output frequency to 1000 MHz as measured on th frequency meter. On the unit under test, turn th XMTR DUPL control to XMTR CHANNEL 160 and the RCVR SIG control to RCVR CHANNEL 1500.

(*c*) Adjust the sweep generator SWEEP WIDTH and CENTER FREQUENCY controls t display the response curve only on the oscillo scope.

(*d*) Adjust signal generator No. 2 output level for a suitable marker amplitude as viewed on the oscilloscope. Readjust the XMTR DUPL control to center the response on the 1000 MHz marker.

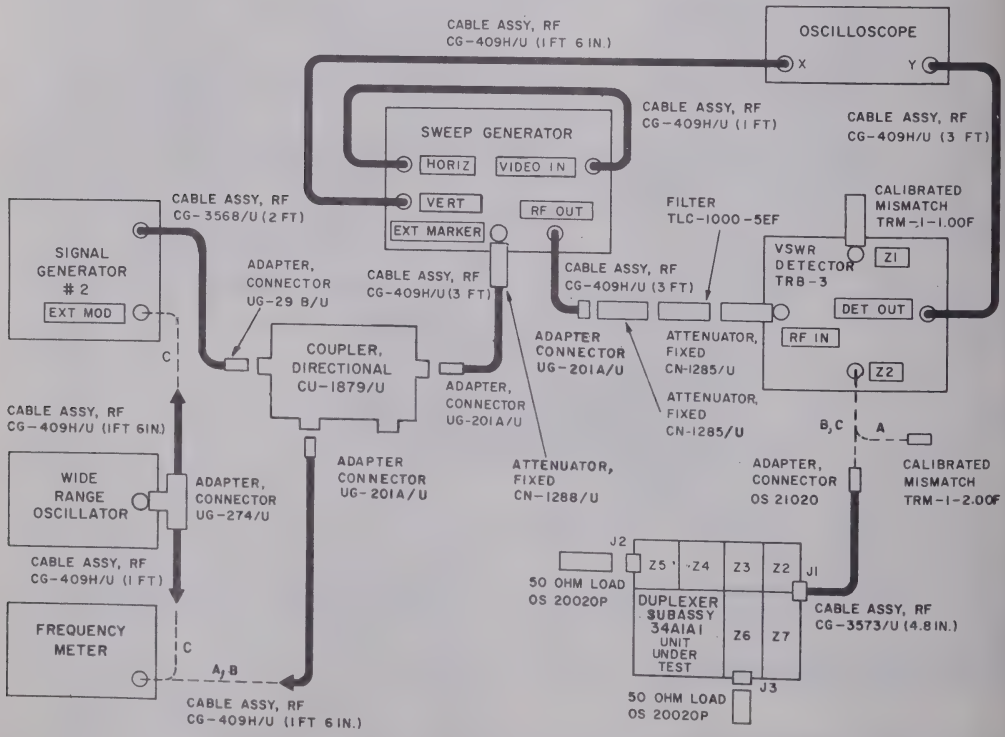


Figure 4–344. Duplexer subassembly 34A1A1, vswr and bandwidth test setup.

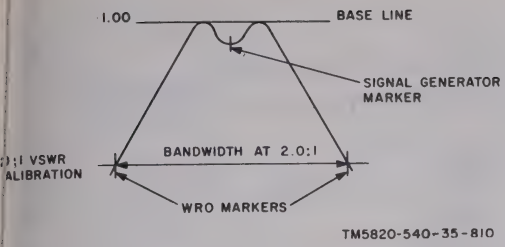


Figure 4–345. Duplexer subassembly 34A1A1 typical vswr response.

(*e*) Connect the test equipment as shown h C, figure 4–344.

(*f*) Adjust the wide range oscillator frequency to place markers at the points where the esponse intersects tht 2.0:1 vswr calibration line s shown in figure 4–345. Note the wide range scillator frequency as indicated on the frequency neter.

(*g*) Multiply the wide range oscillator frequency, obtained in (*f*) above, by 2 to obtain bandwidth. Bandwidth should be greater than 2.0 MHz.

(*h*) Repeat steps (*b*) through (*g*) above using the XMTR CHANNEL, RCVR CHANNEL and signal generator frequencies listed in table below. The bandwidth at the 2.0:1 line should be greater than 2 MHz.

XMTR CHANNEL	RCVR CHANNEL	Sig generator freq. (MHz)
1570	1470	985
1400	1300	900
1200	1100	800
990	1090	695

NOTE

Maintain a minimum of 100 channels separation between XMTR CHANNEL and RCVR CHANNEL while performing step (*i*) below.

(*i*) Tune XMTR CHANNEL from one extreme to the other, and back again, simultaneously tuning signal generator No. 2 output frequency and the sweep generator center frequency to display the passband on the oscilloscope. The bandwidth at the 2.0:1 vswr line should be greater than 2 MHz.

(3) *Receiver filter vswr, bandwidth and backlash.*

(*a*) Connect the test equipment as shown in B, figure 4–344.

(*b*) Tune the signal generator and sweep generator output frequency to 1000 MHz ±1MHz.

(*c*) Turn XMTR DUPL control to XMTR CHANNEL 1500 and RCVR SIG control to RCVR CHANNEL 1600. Repeat (2)(*e*) through (*h*) above.

(*d*) Repeat steps (*a*) and (*b*) above using tht XMTR CHANNEL, RCVR CHANNEL and signal generator frequencies given in the chart below. In each case the bandwidth at the 2.0:1 line should be greater than 2 MHz.

RCVR CHANNEL	XMTR CHANNEL	Signal generator Freq. (MHz)
1570	1470	985
1400	1300	900
1200	1100	800
900	1090	695

(4) *Transmitter filter insertion loss.*

(*a*) Connect the test equipment as shown in A, figure 4–346.

(*b*) Adjust the signal generator output frequency to 1000 MHz, measured on the frequency meter. Turn RCVR SIG control to RCVR CHANNEL 1500 and XMTR DUPL control to XMTR CHANNEL 1600.

(*c*) Set the sweep generator output attenuation to 0 db and adjust the SWEEP WIDTH and CENTER FREQUENCY controls to display the response curve only, on the oscilloscope.

(*d*) Adjust the signal generator output level for a suitable marker amplitude, viewed on the oscilloscope. Readjust XMTR DUPL control to center the response on the 1000 MHz marker.

(*e*) Set the variable attenuators to 0 db and note the response amplitude at the center frequency.

(*f*) Connect the test equipment as shown in B, figure 4–346.

(*g*) Adjust the variable attenuators to return the response amplitude to the amplitude noted in step (*e*) above. Attenuation increase should be no greater than 2.5 db.

(*h*) Connect the test equipment as shown in A, figure 4–346.

(*i*) Turn the RCVR SIG control to RCVR CHANNEL 1090 and the XMTR DUPL control to XMTR CHANNEL 990.

(*j*) Adjust signal generator No. 2 output frequency to 695 MHz, measured on the frequency meter, and output level for a suitable marker amplitude, viewed on the oscilloscope.

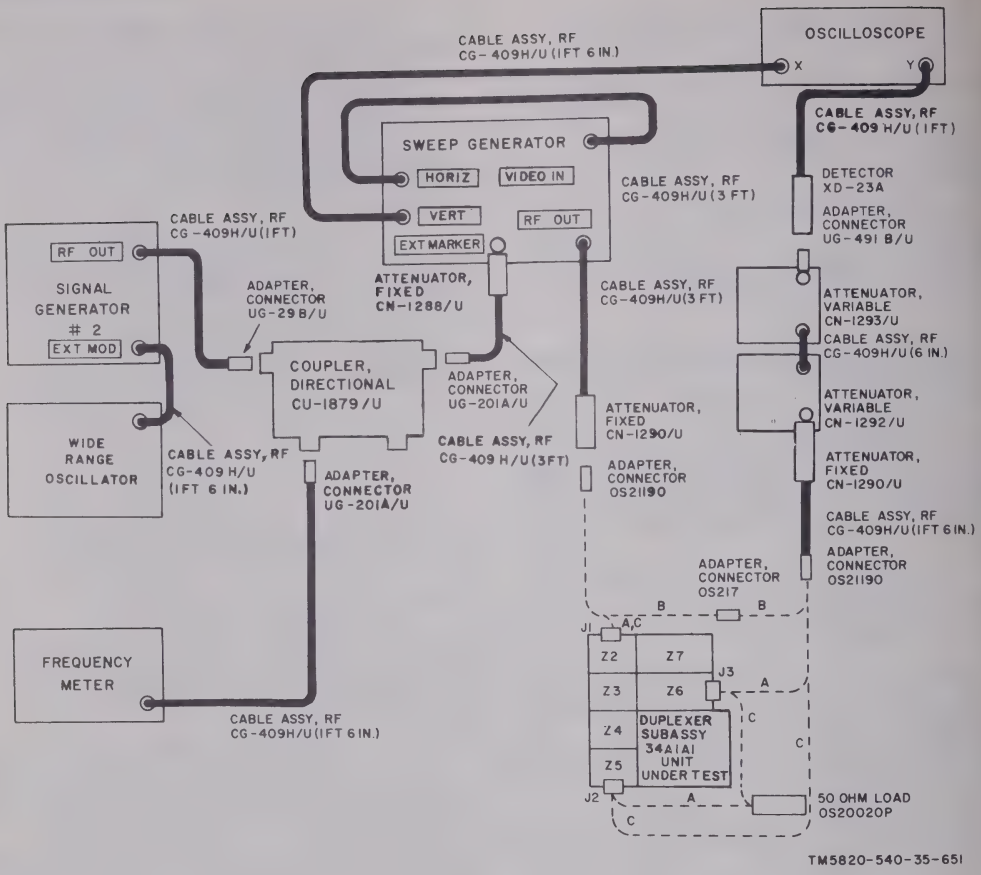


Figure 4–346. Duplexer subassembly 34A1A1 transmitter filter insertion loss, test setup.

(*k*) Readjust the XMTR DUPL control to center the response on the 695-MHz marker.

(*l*) Not used.

(*m*) Set the variable attenuators to 0 db and note the response amplitude at the center frequency.

(*n*) Connect the test equipment as shown in B, figure 4–346.

(*o*) Adjust the variable attenuators to return the response amplitude to the amplitude noted in step (*m*) above. Attenuation increase should be no greater than 2.0 db.

(5) *Receiver filter insertion loss.*

(*a*) Connect the test equipment as shown in C, figure 4–346.

(*b*) Turn the RCVR SIG control to RCVR CHANNEL 1600 and the XMTR DUPL control to XMTR CHANNEL 1500.

(*c*) Set the sweep generator output attenuators to 0 db and adjust the SWEEP WIDTH and CENTER FREQUENCY controls to display the response curve only, on the oscilloscope.

(*d*) Adjust signal generator No. 2 output frequency to 1000 MHz, measured on the frequency meter, and output level for a suitable marker amplitude, viewed on the oscilloscope.

(*e*) Readjust the RCVR SIG control to center the response on 1000 MHz.

(*f*) Set the variable attenuators to 0 db and note the response amplitude at the center frequency.

(*g*) Connect the test equipment as shown in B, figure 4–346.

(*h*) Adjust the variable attenuators to return the response amplitude to the amplitude noted in step (*f*) above. The attenuation increase should be no greater than 3.0 db.

(*i*) Connect the test equipment as shown in C, figure 4–346.

(*j*) Turn the RCVR SIG control to RCVR CHANNEL 990 and the XMTR DUPL control to XMTR CHANNEL 1090.

(*k*) Adjust signal generator No. 2 output frequency to 695 MHz, measured on the frequency meter, and output level for a suitable marker level, viewed on the oscilloscope.

(*l*) Not used.

(*m*) Readjust the RCVR SIG control to center the response on the 695-MHz marker.

(*n*) Repeat steps (*f*) through (*h*) above.

NOTE

For alignment procedures refer to paragraph 5–33.

(6) *RCVR SIG Alignment Check.*

(*a*) Connect the test equipment, as shown in B, figure 4–344. Leave the EXT MARKER cable disconnected.

(*b*) Turn the RCVR SIG control to channel 1600 and turn the XMTR DUPL control fully counterclockwise.

(*c*) Reset the sweep generator to 1000 MHz.

(*d*) With the aid of the markers, adjust the RCVR SIG control until the maximum amplitude of the response is tuned precisely to 1000 MHz.

(*e*) Check to see that channel number 1600 is not more than ⅛ inch above or below the calibration mark (centerline of the RCVR CHANNEL window).

(*f*) Check the alignment of the tape very 20 channels down to channel 990; check to see that the indicated channel and frequency are in the following relationship.

$$\text{Channel number} = 2(\text{Frequency (MHz)} - 200)$$

$$\text{Frequency (MHz)} = \frac{\text{Channel number}}{2} + 200$$

If the tape requires adjustment refer to paragraph 4–202 *b*.

(7) *XMTR DUPL Alignment Check.*

(*a*) Connect the test equipment as shown in B, figure 4–344. Leave the EXT MARKER cable disconnected.

(*b*) Turn the XMTR DUPL control to channel 1600 and the RCVR SIG control fully counterclockwise.

(*c*) Reset the sweep generator to 1000 MHz.

(*d*) With the aid of the markers adjust the XMTR DUPL control until the maximum amplitude of the response is tuned precisely to 1000 MHz.

(*e*) Check to see that the channel number 1600 is not more than ⅛ inch above or below the calibration mark (center line of the XMTR CHANNEL window).

(*f*) Check the alignment of the tape every 20 channels as described in (6)(*f*) above.

(*g*) If the tape requires adjustment, refer to paragraph 4–202*c*.

4–174. Connector-Filter Assembly 34A1W1A1

a. Test Equipment and Material Required.

Equipment	*Common name*
Multimeter TS–352B/---------	Multimeter

b. Test Procedure. This assembly comprises plugs 34A1W1A1P1, 34A1W1A1P2 and 34A1W1A1J2 (figs. 3–69 and 3–76). Check each circuit as follows (fig. 8–7):

(1) Check continuity between each pin of 34A1W1A1P1 and its associated filter connector and between RF connectors A1 and A2 of 34A1W1A1P1 and 34A1W1A1P2 and 34A1W1A1J2.

(2) Check for short circuits between all pins and center conductors of RF connectors and ground.

c. Repairs.

(1) The RF connectors in 34A1W1A1P1 can be replaced as follows:

(*a*) Force the RF connectors back into the connector-filter assembly.

(*b*) Slide the insulating sleeve back along the cable and unsolder the faulty connector.

(*c*) Install the new connector on the RF cable (para 4–10).

(*d*) Push the new connector into the mounting hole in 34A1W1A1P1 until the retaining springs snap into place, holding the connector firmly.

(2) If 34A1W1A1P1, 34A1W1A1P2 or 34A1W1A1J2 are damaged beyond repair, refer to paragraph 4–204 for replccement procedures.

4–175. Frequency Multiplier Group 34A2

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Test Facility Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Generator, Sweep SG–888	Sweep generator
Oscilloscope AN/USM–281	Oscilloscope
WATTMETER AN/URM–98	Power meter
Trombone Line General Radio 874–LTL.	Trombone line
Adapter-Connector Omni Spectra 21010.	Adapter-connector OS21010
Generator, Signal SG–340A/G	Signal generator No. 2
Frequency Meter AN/USM–159.	Frequency meter
Cable Assembly, Special Purpose Electrical SAC–SK–014.	Test jig
Wideband RF Amplifier, Test Jig SAC–SK–012.	Adapter-connector OS21020
Adapter-Connector Omni Spectra 21020.	
Adapter-Connector 874–QNJA (2 required).	Adapter-connector OS21180
Adapter-Connector Omni Spectra 21180.	

b. Test Procedures.

(1) *Output checks.*

(*a*) Connect the test equipment as shown in A, figure 4–347.

(*b*) Adjust the sweep generator controls to provide a sweep between 105 and 140 MHz, at an input level to the unit under test of +15 dbm (+2 dbm power meter indication).

(*c*) Connect the test equipment as shown in B, figure 4–347.

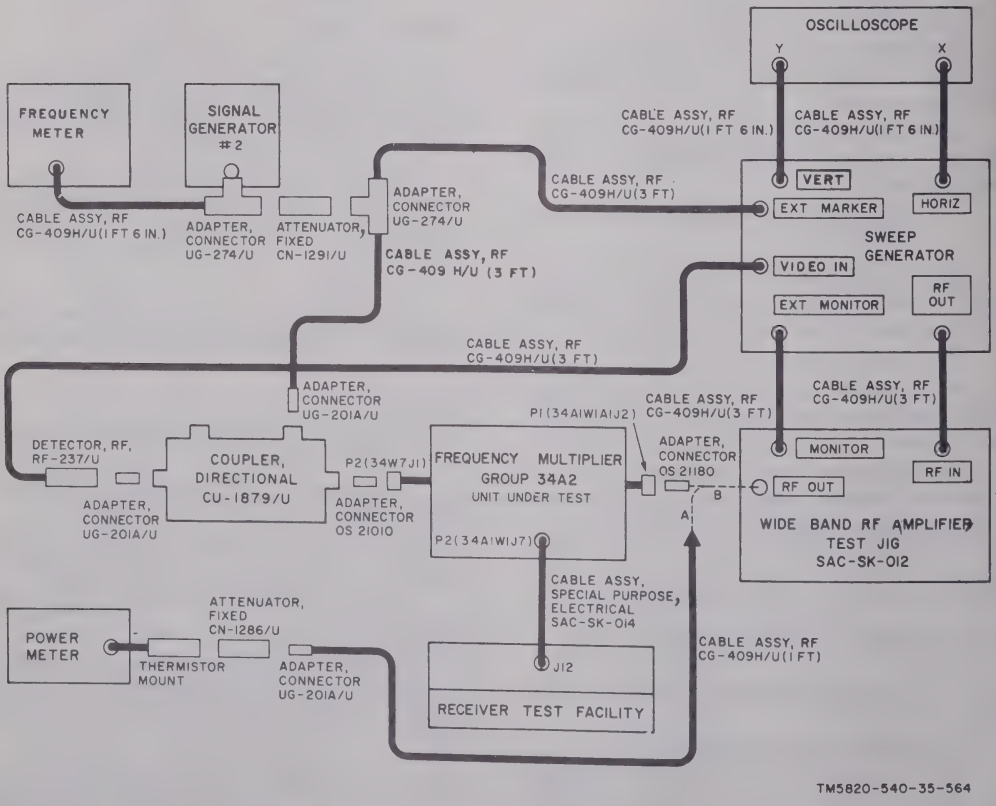


Figure 4–347. Frequency multipler group 34A2, output check and alignment, test setup.

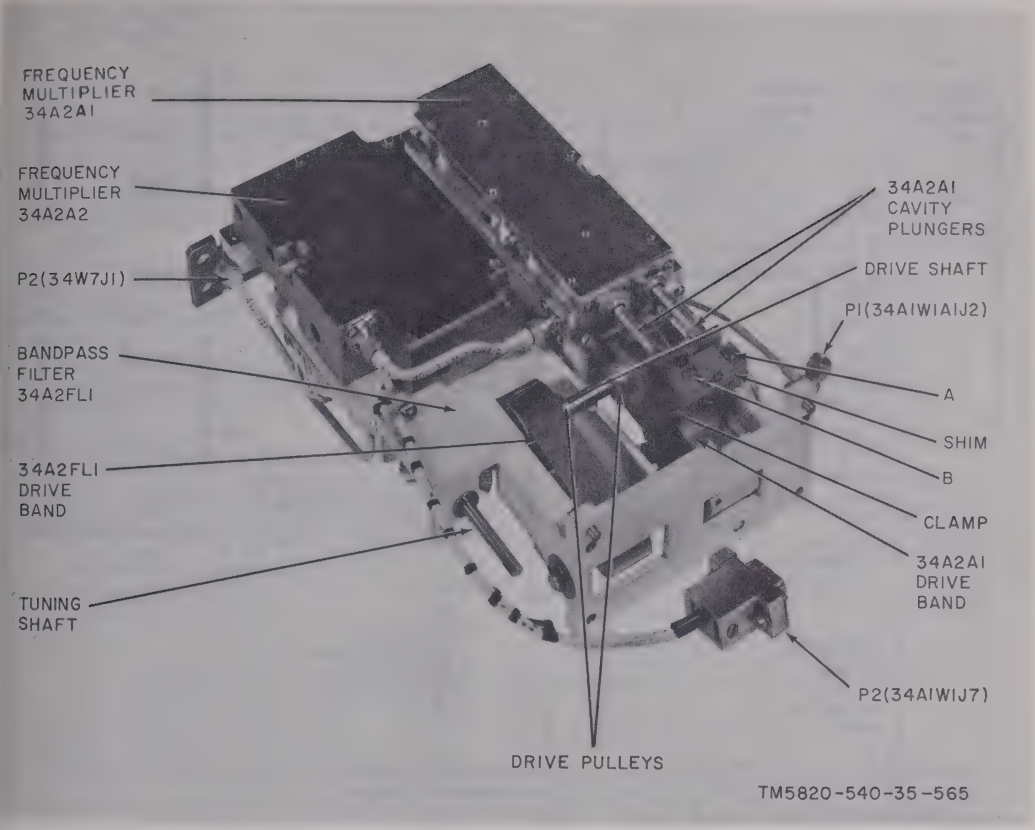


Figure 4–348. Frequency multiplier group 34A2, top view.

(*d*) Set the test facility switches S1 to ON and S6 to OSC.

(*e*) Turn the tuning shaft (fig. 4–348) until the bandpass filter and frequency multiplier 34A2A1 cavity plungers are fully in the cavities.

(*f*) Adjust the oscilloscope controls for a convenient display.

(*g*) Simultaneously turn the tuning shaft of the unit under test and tune the signal generator (used as a marker generator) from 725 to 1030 MHz. Record the output frequencies of the lowest and the highest power level as displayed on the oscilloscope. Determine the corresponding input frequencies by dividing the signal generator frequency by six for frequencies of 840 MHz and below, and by eight for frequencies of 840 MHz and above.

NOTE

A marker will appear only when there is an output at that frequency.

(*h*) Connect the test equipment as shown in figure 4–349.

(*i*) Tune the signal generator to the frequency of the lowest output recorded in (*g*) above.

(*j*) Adjust the sweep generator to provide the corresponding input frequency with a sweep width of 10 MHz.

(*k*) Tune the unit under test, by turning the tuning shaft (fig. 4–348), for a peak response on the oscilloscope at the signal generator frequency.

(*l*) Not used.

(*m*) Gradually adjust the sweep generator sweep width control fully counterclockwise, main-

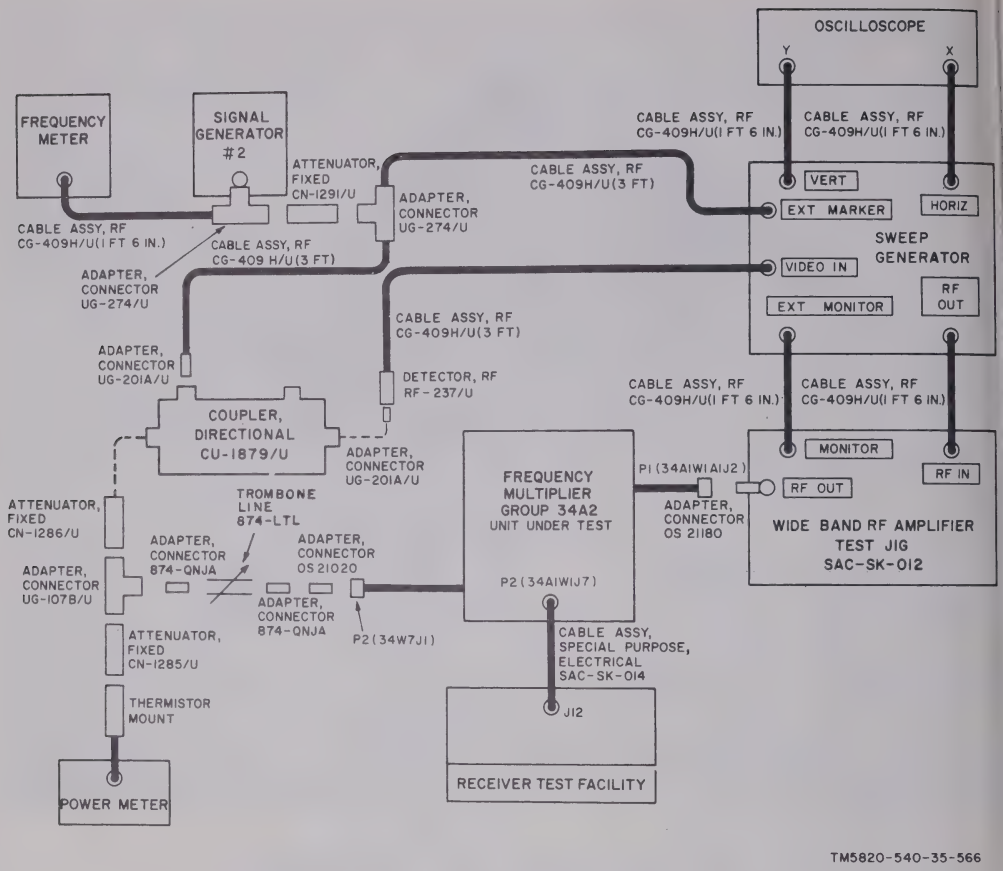


Figure 4–349. Frequency multiplier group 34A2, output power check, test setup.

taining the external marker on display by fine tuning the sweep generator frequency.

(*n*) Adjust the trombone line for a minimum indication on the power meter. The power output must be at least +6.5 dbm (—2.5 dbm power meter indication).

(*o*) Tune the signal generator to the frequency of highest output as noted in step (*g*) above.

(*p*) Repeat steps (*j*) through (*m*) above.

(*q*) Adjust the trombone line for a minimum indication on the power meter. The power output must not exceed +14 dbm (+5 dbm power meter indication).

(*r*) Repeat steps (*a*) through (*q*) above for a +13 dbm input level to the unit under test.

(2) *Input vswr check.*

(*a*) Connect the test equipment as show in A, figure 4–350.

(*b*) Adjust the sweep generator controls t provide a 105-MHz cw signal indicated on the fr quency meter, at an input level to the unit unde test of +17 dbm (+7 dbm power meter indica tion).

(*c*) Connect the test equipment as show in B, figure 4–350.

(*d*) Set the test facility switches S1 to O and switch S6 to OSC.

(*e*) Record the power meter indication.

(*f*) Reverse the input and output connec tions of the directional coupler (the secondar ports remaining connected to the test equipment) The power level (reflected power) must be at leas 11.3 db lower than that recorded in step (*e*

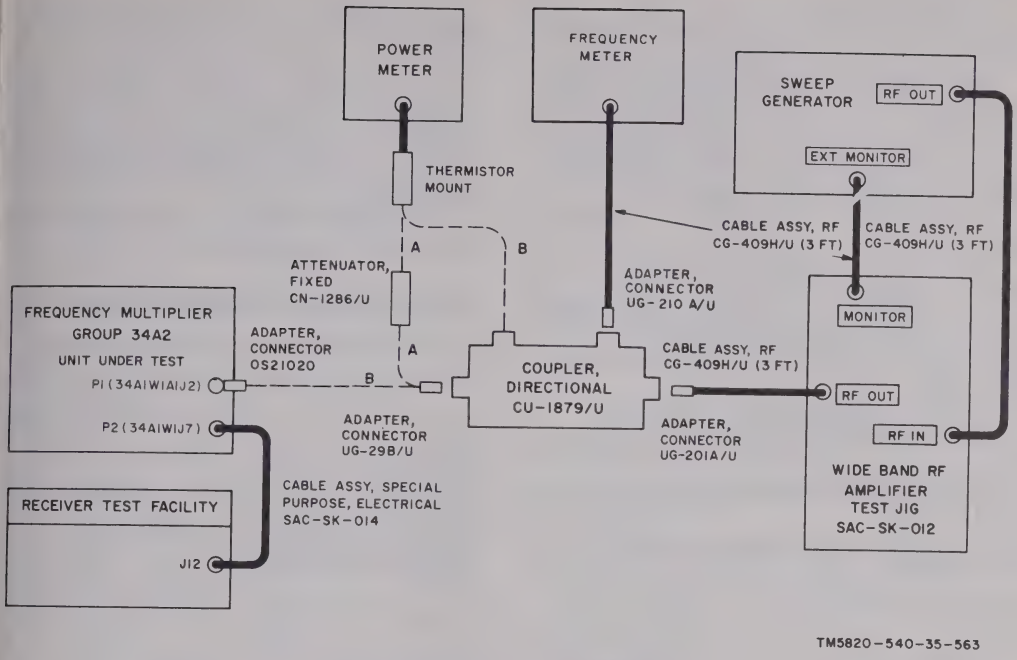


Figure 4–350. Frequency multiplier group 34A2 input vswr check, test setup.

bove. This represents a vswr of better than 1.75:1.

(*g*) Remove the input and output connections of the directional coupler and repeat steps (*c*), (*e*) and (*f*) above for sweep generator frequencies of 110 MHz, 120 MHz, 130 MHz and 140 MHz.

c. Troubleshooting (fig. 8–6).

Symptom	Probable cause	Checks and corrective measures
. High vswr	Defective frequency multiplier 34A2A2 (fig. 4–348).	Replace frequency multiplier 34A2A2 (para 3–130) and test defective unit as shown in para 4–177.
. Low or no power output	*a.* Defective frequency multiplier 34A2A2.	*a.* Disconnect P1 (34A2W1P1) from J1 of frequency multiplier 34A2A2 and connect the power meter to J1 (fig. 3–74). Power meter should indicate +5 dbm ±2 db. If output is abnormal replace frequency multiplier 34A2A2 (para 3–130) and test defective unit as shown in para 4–177.
	b. Defective frequency multiplier 34A2A1 (fig. 4–348).	*b.* If power at J1 is normal, reconnect P1 to J1. Disconnect P1 (34A2FL1P1) from J2 of frequency multiplier 34A2A1 and connect the power meter to J2 (fig. 3–75). Power meter should indicate at least −3 dbm. If output is abnormal replace frequency multiplier 34A2A1 (para 4–207) and test defective unit as shown in para 4–176.
	c. Defective bandpass filter 34A2FL1 (fig. 4–348).	*c.* If power at J2 of frequency multiplier 34A2A1 is normal, test bandpass filter 34A2FL1 as shown in para 4–180.
	d. Alignment	*d.* If misalignment is suspected refer to *d* below for complete alignment procedures.

d. Alignment Procedure.

(1) Turn the tuning shaft (fig. 4–348) until the cavity plungers are fully in the cavities.

(2) Check that the two clamps on the drive bands (fig. 4–348) are in line. If required, readjust the pulleys on the drive shaft (fig. 4–348).

(3) Loosen screws A and B on the clamp at the end of 34A2A1 cavity plungers.

(4) Connect the test equipment as shown in A, figure 4–347.

(5) Adjust the sweep generator controls to provide a frequency of 122 MHz with a sweep width of 10 MHz and an input level to the unit under test of +15 dbm (+2 dbm power meter indication).

(6) Tune signal generator to 730 MHz.

(7) Connect the test equipment as shown in B, figure 4–347.

(8) Set the test facility switches S1 to ON and S6 to OSC.

(9) Adjust the oscilloscope controls for a suitable display.

(10) Slowly turn the tuning shaft on the un under test until the output peaks on the sign generator frequency (external marker).

(11) Readjust frequency multiplier 34A2A by moving its cavity plungers in or out. Simu taneously maintain the highest output from th bandpass filter at 730 MHz by adjusting th tuning shaft.

(12) Tighten screws A and B without chang ing the position of the plungers.

4–176. Frequency Multiplier 34A2A1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit

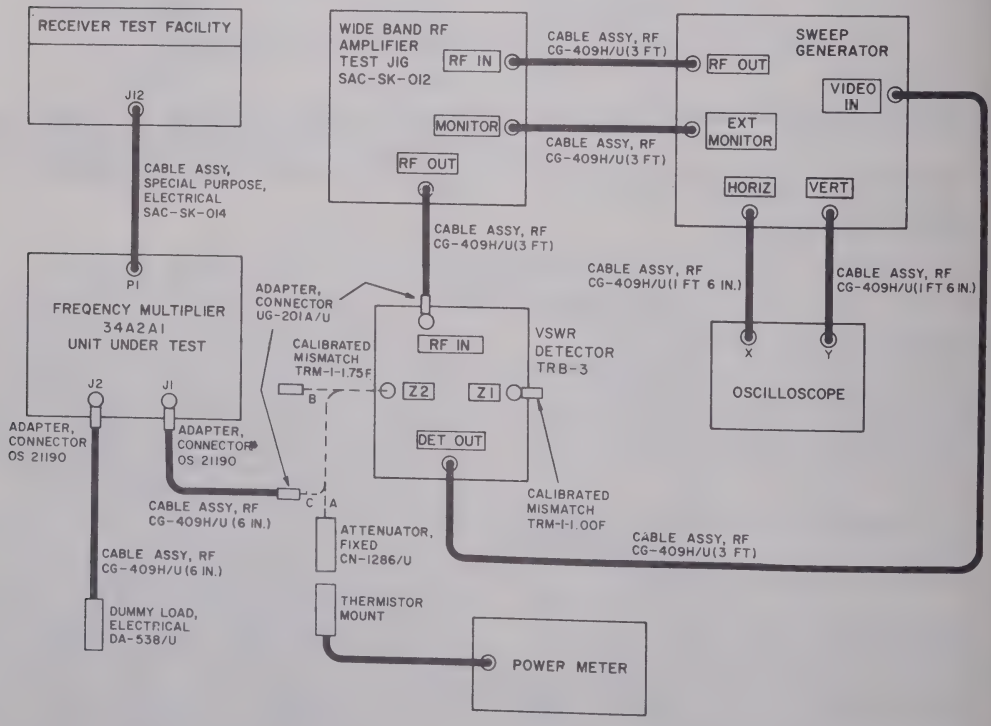


Figure 4–351. Frequency multiplier 34A2A1 vswr check, test setup.

Equipment	Common name
Voltmeter, Electronic ME–247/U.	RF voltmeter
Frequency Meter AN/USM–159.	Frequency meter
Multimeter TS–352B/U	Multimeter
Generator, Signal SG–340A/G	Signal generator No. 2
Generator, Signal SG–409( )/U.	Signal generator No. 1
Wattmeter AN/URM–98	Power meter
Generator, Sweep SG–888	Sweep generator
Generator, Signal AN/USM–205.	Wide range oscillator
Oscilloscope AN/USM–281	Oscilloscope
Trombone Line General Radio 874–LTL.	Trombone line 874–LTL
Adapter-Connector UG–107B/U.	
Adapter-Connector 874–QNJA (2 required).	
Adapter-Connector Omni Spectra 21020.	Adapter-connector OS21020
Adapter-Connector Omni Spectra 21190 (2 required).	Adapter-connector OS21190
Wideband RF Amplifier Test Jig SAC–SK–012.	Wideband WF amplifier test jig.
Cable Assembly Special Purpose, Electrical SAC–SK–014.	
Inside Vernier Calipers, Motutoyo P–52 Feeler Gages, Ludell	

b. Test Procedures.

(1) *Input vswr check.*

(*a*) Connect the test equipment as shown in A, figure 4–351.

(*b*) Set the sweep generator controls to sweep the frequency range 210 to 280 MHz.

(*c*) Set the sweep generator output for a level of +17 dbm at Z2 of the vswr detector (+4 dbm power meter indication).

(*d*) Connect the test equipment as shown in B, figure 4–351.

(*e*) Calibrate the oscilloscope for a vswr of 1.75:1 between 210 and 280 MHz.

(*f*) Connect the test equipment as shown in C, figure 4–351.

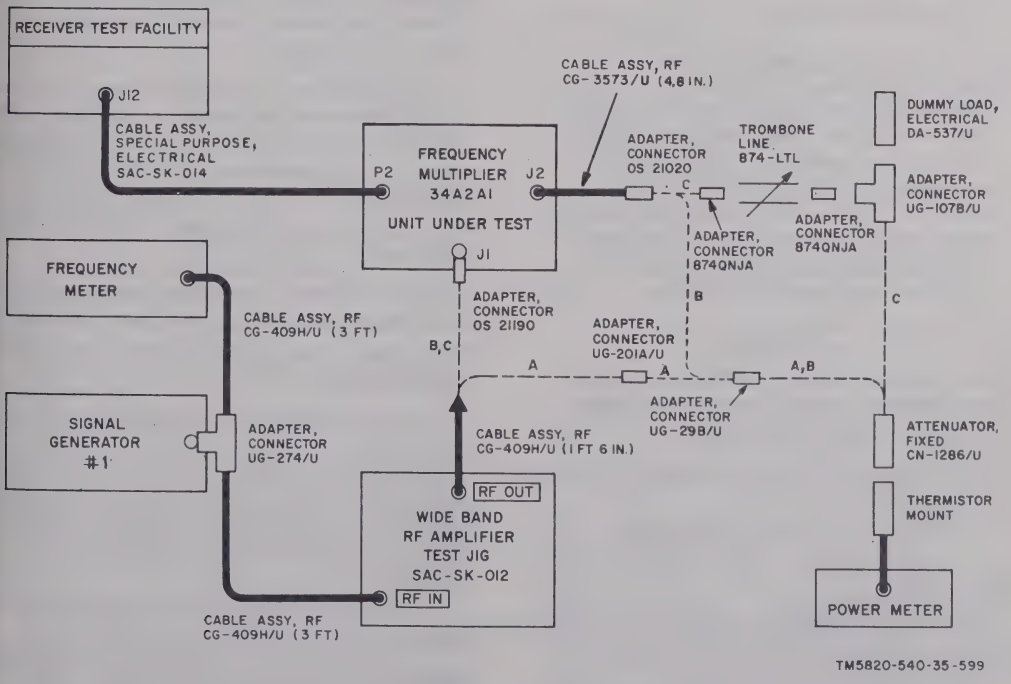


Figure 4–352. Frequency multiplier 34A2A1 tuning law check and output power check, test setup.

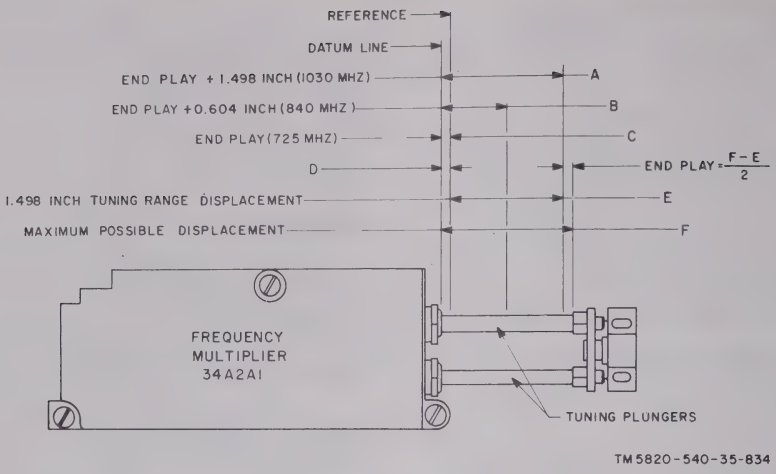


Figure 4–353. Frequency multiplier 34A2A1 tuning plunger displacement measurements.

(*g*) Adjust C9 (fig. 4–355) on the unit for minimum reflected power over the frequency range. Vswr of unit under test should not exceed 1.75:1.

(2) *Tuning law check.*

NOTE 1

The tuning law of the assembly under test is such that a displacement of 1.498 inch of the resonator must tune the assembly over the required frequency range of 725 to 1030 MHz. The maximum possible displacement of the resonator is greater than 1.498 inch and will vary from one assembly to another.

NOTE 2

Use vernier calipers for measurements greater than 0.080 inch and use feeler gages for smaller dimensions.

(*a*) Connect the test equipment as shown in A, figure 4–352.

(*b*) Adjust signal generator No. 1 frequency for 257.5 MHz ± 30 kHz indicated on the frequency meter.

(*c*) Adjust signal generator No. 1 output level for +17 dbm at RF OUT of the test jig (+7 dbm indicated on the power meter).

(*d*) Connect the test equipment as shown in B, figure 4–352.

(*e*) On the unit under test, fully withdraw the tuning plungers and measure the maximum displacement as shown in F, figure 4–353. From this measurement subtract the tuning range displacement of 1.498 inch (E, fig. 4–353). Divide the result by two and record this result as the end play (D, fig. 4–353).

(*f*) Adjust the depth of the tuning plungers for maximum indication on the power meter. The power output should be +8.8 dbm minimum (power meter indication of —1.2 dbm). The displacement of the tuning plungers minus the end play recorded in (*e*) above should be 1.498 ± 0.020 inch.

(*g*) Connect the test equipment as shown in A, figure 4–352 and adjust signal generator No. 1 frequency to the next input frequency shown in the table below.

(*h*) Connect the test equipment as shown in B, figure 4–352 and repeat step (*f*) above for the corresponding output frequency shown in the table below. The power output and displacement of the tuning plungers should be as shown in the table below.

(*i*) Repeat (*g*) and (*h*) above for the remaining frequencies in the table below and record the frequency between 840 MHz and 1030 MHz and the frequency between 840 MHz and 725 at which the output power is lowest.

Output frequency (MHz)	Input frequency (MHz)	Power output (+dbm) min.	Resonator displacement inches from reference
1030	257.5	8.8	1.498±0.020
1020	255.0	8.8	1.450±0.020
1010	252.5	8.8	1.404±0.020
1000	250.0	8.8	1.360±0.020
990	247.5	8.8	1.294±0.020
980	245.0	8.8	1.276±0.020
970	242.5	8.8	1.232±0.020
960	240.0	8.8	1.188±0.020
950	237.5	8.8	1.148±0.020
940	235.0	8.8	1.100±0.020
930	232.5	8.8	1.058±0.020
920	230.0	8.8	1.014±0.020
910	227.5	8.8	0.966±0.020
900	225.0	8.8	0.916±0.020
890	222.5	8.8	0.868±0.020
880	220.0	8.8	0.816±0.020
870	217.5	8.8	0.762±0.020
860	215.0	8.8	0.712±0.020
850	212.5	8.8	0.658±0.020
840	210.0	8.8	0.604±0.020
840	280.0	7.8	0.604±0.020
830	276.7	7.8	0.548±0.020
820	273.3	7.8	0.492±0.020
810	270.0	7.8	0.432±0.020
800	266.7	7.8	0.376±0.015
790	263.3	7.8	0.316±0.015
780	260.0	7.8	0.258±0.015
770	256.7	7.8	0.198±0.015
760	253.3	7.8	0.142±0.012
750	250.0	7.8	0.092±0.012
740	246.7	7.8	0.046±0.012
730	243.3	7.8	0.012±0.012
725	241.7	7.8	0.000±0.000 (REF)

(3) *Output power.*

(*a*) Connect the test equipment as shown in A, figure 4–352.

(*b*) Tune the signal generator to the higher frequency recorded in (2)(*i*) above and adjust its output level for +15 dbm from the wideband RF amplifier (+5 dbm power meter indication).

(*c*) Connect the test equipment as shown in C, figure 4–352.

(*d*) Set the tuning plungers on the unit under test to the displacement position corresponding to the frequency used in step (*b*) above and adjust for maximum power meter indication.

(*e*) Adjust the trombone line for minimum power meter indication. The power level at the output of the unit under test should be at least +7 dbm (—6 dbm power meter indication).

(*f*) Repeat (*a*) through (*d*) above for the power frequency recorded in (2)(*i*) above.

(*g*) Adjust the trombone line for minimum power meter indication. The power level at the output of the unit under test should be at least +8 dbm (—5 dbm power meter indication).

(*h*) Repeat (*a*) through (*g*) above for an input level of +19 dbm.

(4) *Bandwidth.*

(*a*) Connect the test equipment as shown in A, figure 4–354.

(*b*) Set the sweep generator SWEEP WIDTH control to CW and adjust the output frequency for 257.5 MHz indicated on the frequency meter.

(*c*) Set the variable attenuator to 0 db.

(*d*) Set the tuning plunger displacement to 1.498 inch plus the end play recorded in (2)(*e*) above.

(*e*) Connect the test jig output to the power meter as shown in B, figure 4–354.

(*f*) Adjust the sweep generator output level for +17 dbm at the output of the test jig (+7 dbm indication on the power meter).

(*g*) Connect the test equipment as shown in C, figure 4–354.

(*h*) Set signal generator No. 2 output attenuator to 0 dbm and adjust the output frequency for 1030 MHz ± 125 kHz indicated on the frequency meter.

(*i*) Connect the test equipment as shown in D, figure 4–354.

(*j*) Not used.

(*k*) Set the sweep generator SWEEP WIDTH control to WIDE and adjust the sweep generator and the oscilloscope controls to display the output response curve.

(*l*) Not used.

(*m*) Mark the oscilloscope face at the peak of the response curve.

(*n*) Set the variable attenuator to 3 db and mark the new response curve peak on the oscilloscope.

(*o*) Return the variable attenuator to 0 db.

(*p*) Adjust the wide range oscillator frequency to place markers on the response curve at the —3 db reference line. If necessary, adjust signal generator No. 2 frequency to place markers on the —3 db line. The bandwidth at the —3 db line is twice the wide range oscillator frequency and should be between 8.2 MHz and 30.9 MHz.

(*q*) Repeat (*a*) through (*p*) above for the equipment settings shown below.

Sweep generator center freq. (MHz)	Signal generator No. 2 freq. (MHz)	Bandwidth at—3 db points (MHz)		Tuning plunger displacement (inches)
		Min	Max	
280	840	6.7	25.2	0.604
210	840	6.7	25.2	0.604
241.7	725	5.8	21.8	0

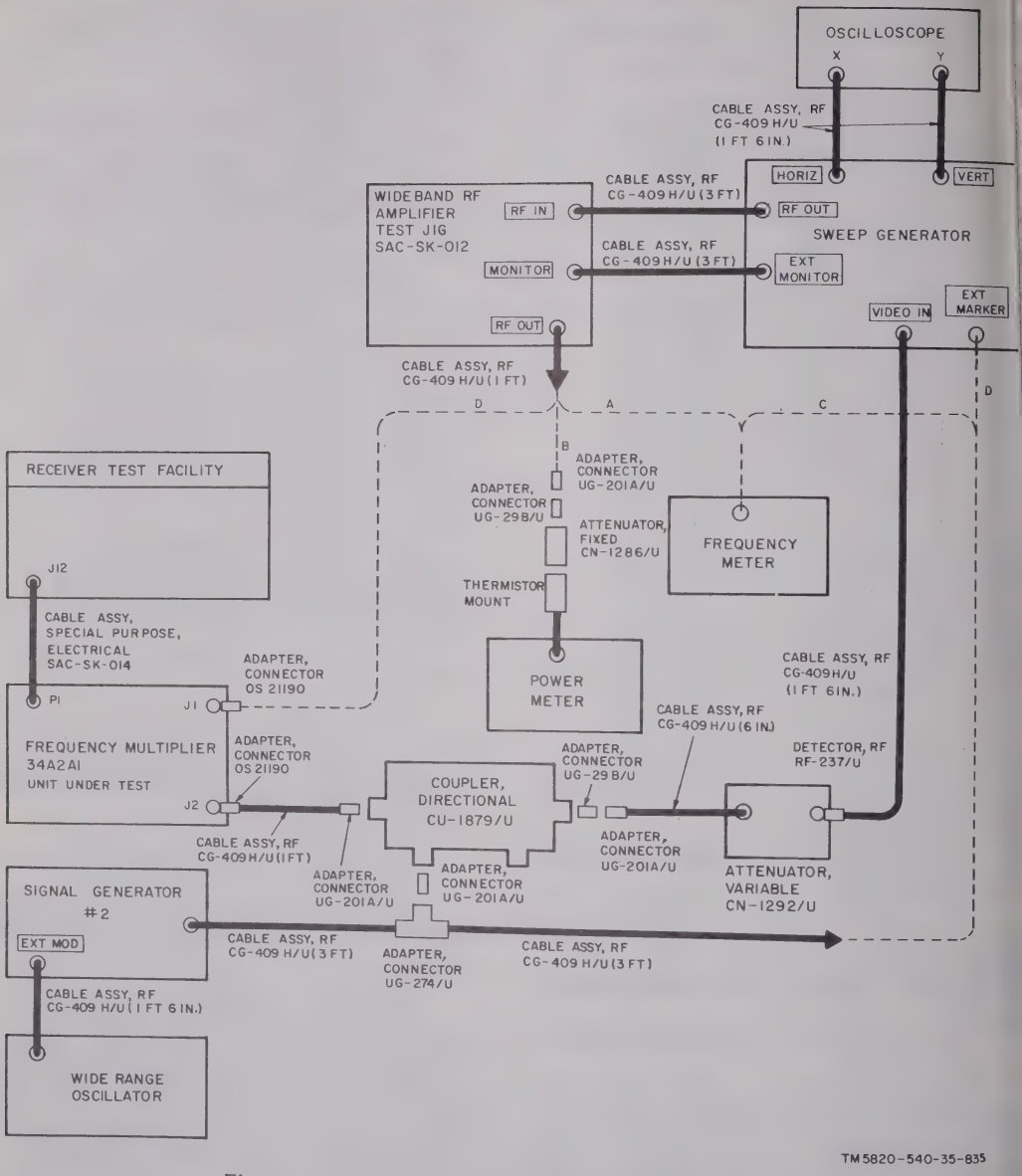


Figure 4-354. Frequency multiplier 34A2A1 bandwidth check and alignment, test setup.

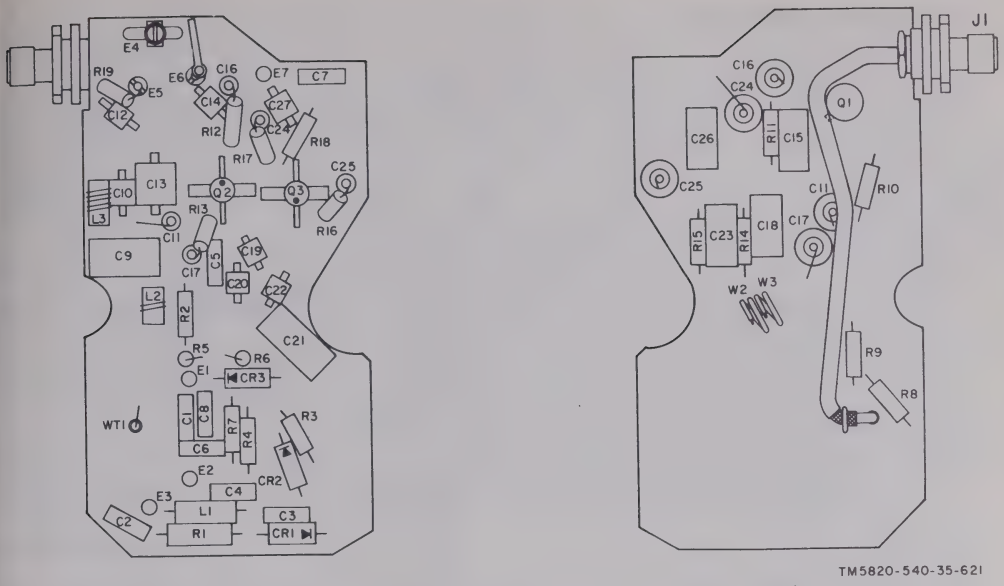


Figure 4–355. Frequency multiplier 34A2A1 parts location.

c. Troubleshooting (fig. 8–9).

Symptom	Checks and corrective measures
1. High vswr (*b*(1)(*g*) above)	*a.* Check resistors R8 and R9 (fig. 4–355) and input connector J1. *b.* Check components in Q1 base circuit (fig. 7–11).
2. No output indication (*b*(2)(*f*) above)	*a.* Check the dc voltages as established in *d* below. Investigate any abnormal indication. Replace components as required. *b.* Check for damaged cables or connectors and broken wires. Repair or replace as required.
3. Low output, tuning law or bandwidth outside specified limits.	Realign unit as shown in *e* below.

d. Voltage and Resistance Measurements (fig. 8–9).

NOTE

Use the allocated multimeter for resistance and voltage measurements and alocated RF voltmeter for RF voltage measurements.

(1) *DC voltage measurements referenced to ground.*

Test points	Typical indication (volts dc)
34A2A1A1Q1—base	−6.3
—emitter	−6.3
34A2A1A1Q2—base	+0.62
—collector	+5.4
34A2A1A1Q3—base	+0.62
—collector	+5.4

(2) *RF voltage measurements referenced to ground.*

Test points	Typical indication (volts rms)
34A2A1A1Q1—base	0.475
—collector	0.13
34A2A1A1Q2—base	0.14
—collector	0.5
34A2A1A1Q3—base	0.13
—collector	0.5

(3) *Resistance measurements.*

Stage	Transistor		Base (−)				Base (+)			
	Ref.	Type	Emitter (+)		Collector (+)		Emitter (−)		Collector (−)	
			Res (ohms)	Multimeter range	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range	Res (ohms)	Multimeter range
Frequency Multiplier 34A2A1A1.	Q1	2N2857	450	X 100	3.1k	X 100	455	X 100	1.05k	X 100
	Q2	5762	860	X 100	1.125k	X 100	1.05k	X 100	960	X 100
	Q3	5762	880	X 100	1.1k	X 100	1.0k	X 100	960	X 100

e. Alignment.

NOTE 1

The tuning law of the assembly under test is such that a displacement of 1.498 inch of the resonator must tune the assembly over the required frequency range of 725 to 1030 MHz. The maximum possible displacement of the resonator is greater than 1.498 inch and will vary from one assembly to another. It is therefore necessary to measure this maximum possible displacement and arrange for the 1.498 inch tuning displacement to fall provisionally in the center of this maximum resulting in equal end play. Electrical alignment will then be performed to make the assembly conform to the tuning law. Should this not be possible, the 1.498 inch tuning displacement may be offset from the center of maximum possible displacement and alignment repeated to meet the tuning law.

NOTE 2

Use vernier calipers for measurements greater than 0.080 inch and use feeler gages for smaller dimensions.

(*a*) On the unit under test, fully withdraw the tuning plungers and measure the maximum displacement as shown in F, figure 4–353. From this measurement subtract 1.498 inch (tuning range displacement). Divide the result by two and record as the end play (D, fig. 4–353).

(*b*) Add 1.498 inch to the end play recorded in (*a*) above and set the plungers to this displacement (A, fig. 4–353).

(*c*) Connect the test equipment as shown in A, figure 4–354.

(*d*) Set the sweep generator SWEEP WIDTH control to CW and adjust the output frequency for 257.5 MHz nominal indicated on the frequency meter.

(*e*) Connect the test equipment as shown in B, figure 4–354.

(*f*) Adjust the sweep generator output level for +17 dbm at the test jig output (+7 dbm indication on the power meter).

(*g*) Connect the test equipment as shown in C, figure 4–354.

(*h*) Set signal generator No. 2 output attenuator to 0 dbm and adjust the output frequency for 1030 MHz ± 125 kHz indicated on the frequency meter.

(*i*) Connect the test equipment as shown in D, figure 4–354.

(*j*) Set the sweep generator SWEEP WIDTH control to WIDE and adjust the sweep width and the oscilloscope controls to display the output response curve.

(*k*) Adjust C3 and C21 (fig. 4–356) to center the response on the 1030 MHz marker and adjust C1 (fig. 4–356) for maximum response. Note the response amplitude.

(*l*) Not used.

(*m*) Add 0.604 inch to the end play recorded in (*a*) above and set the tuning plungers to this displacement (B, fig. 4–353).

(*n*) Repeat steps (*c*) through (*j*) above for signal generator No. 2 frequency of 840 MHz ± 125 kHz and sweep generator center frequency of 280 MHz.

(*o*) Remove the cover from the plug P1 side of the unit under test and adjust the position of E4 (fig. 4–355) for maximum response at 840 MHz.

(*p*) Repeat steps (*b*) through (*j*) above. The response curve amplitude should be approximately the same as that noted in step (*k*) above. If necessary, adjust C1.

(*q*) Repeat steps (*m*) through (*o*) above and readjust E4 for maximum response at 840 MHz.

(*r*) Set the tuning plungers to the end play recorded in (*a*) above and repeat steps (*c*) through (*j*) above for signal generator No. 2 frequency of 725 MHz ± 125 kHz and sweep generator center frequency of 261.7 MHz.

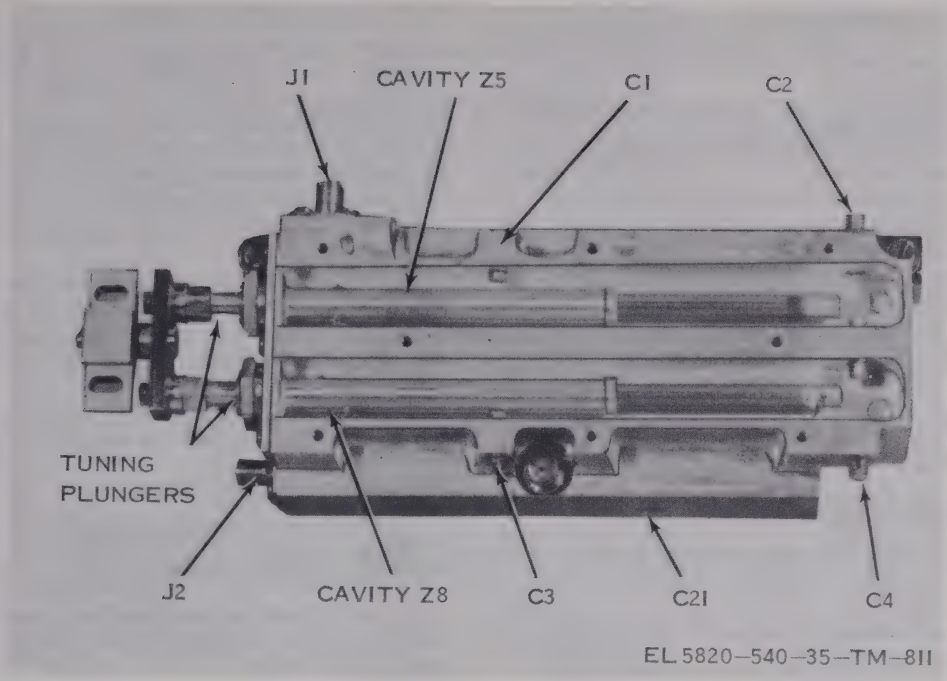


Figure 4-356. Frequency multiplier 34A2A1 showing turned cavities with cover removed.

(*s*) Adjust C4, C2 and C21 (fig. 4-356) for maximum response at 725 MHz.

(*t*) Perform the tuning law check in *b*(2) above. If the power output or the resonator displacement are not as specified, the tuning range displacement should be offset from the center of maximum possible displacement by slightly altering the end play recorded in (*a*) above.

(*u*) Repeat (*b*) through (*t*) above until the requirements are met.

4-177. Frequency Multiplier 34A2A2

Frequency multiplier 34A2A2 is identical to frequency multiplier 34A2A2. Refer to paragraph 4-124 for complete test and alignment procedures.

4-178. Low-Pass Filter 34A2A2FL1

Low-pass filter 34A2A2FL1 is identical to low-pass filter 33A2A2FL1. Refer to paragraph 4-125 for complete test and alignment procedures.

4-179. Low-Pass Filter 34A2A2FL2

Low-pass filter 34A2A2FL2 is identical to low-pass filter 33A2A2FL2. Refer to paragraph 4-126 for complete test and alignment procedures.

4-180. Bandpass Filter 34A2FL1

a. Test Equipment and Materials Required.

Equipment	Common name
Accessory Kit Test Facilities Set MK-1173(V)1/GRM-95(V).	Accessory kit
Test Facility, Receiver TS-2867(V)1/GRM-95(V).	Receiver test facility
Generator, Sweep SG-888	Sweep generator
Oscilloscope AN/USM-281	Oscilloscope
Detector, RF XD-23A	Detector XD-23A
Generator, Signal SG-340A/G	Signal generator No. 2
Frequency Meter AN/USM-159.	Frequency meter
Indicator, Standing Wave Ratio AN/UPM-108.	Vswr indicator
Band III Receiver Bandpass Filter Tuning Law Test Jig SM-E-696048.	Test jig
Dummy Load, Telonic TRM-1-1.60F.	Calibrated mismatch TRM-1-1.60F.
Adapter-Connector Omni Spectra 21010.	Adapter-connector OS21010

Equipment	Common name
Adapter-Connector Omni Spectra 21170.	Adapter-connector OS21170
Adapter-Connector Omni Spectra 21180.	Adapter-connector OS21180

b. Test Procedures.

(1) *Bandwidth check.*

(*a*) Install the unit under test in the test jig and secure with the four captive screws. Tighten the test jig bellows clamp to the tuning shaft (fig. 4–359) of the unit under test.

(*b*) Lift the test jig hinged gage to the up position.

(*c*) Turn the test jig knurled thumbscrew to tune the unit under test to the 725 MHz calibrated slot on the test jig hinged gage. Lower the hinged gage.

(*d*) Connect the test equipment as shown in A, figure 4–357.

(*e*) Set the coaxial switch to position 2.

(*f*) Adjust the sweep generator controls to provide maximum output at a frequency of 725 MHz with a sweep of sufficient width to view the response curve.

(*g*) Adjust the oscilloscope controls for a convenient display and using the sweep generator markers, check that the response is centered on 725 MHz.

(*h*) Decrease the sweep generator output level by 3 db and mark the new peak amplitude of the response curve on the oscilloscope. This is the —3 db bandwidth reference line.

(*i*) Return the sweep generator output level to maximum.

(*j*) Measure the bandwidth at the points where the response curve crosses the —3 db bandwidth reference line, using the sweep generator markers. The bandwidth should be between 5 MHz and 10 MHz.

(*k*) Repeat (*b*) through (*j*) above for sweep generator and test jig frequencies of 880 MHz and 1030 MHz.

(2) *Vswr check.*

(*a*) Connect the test equipment as shown in B, figure 4–357.

(*b*) Set the coaxial switch to position 1.

(*c*) Adjust the sweep generator controls to provide a sweep between 725 and 1030 at maximum output level.

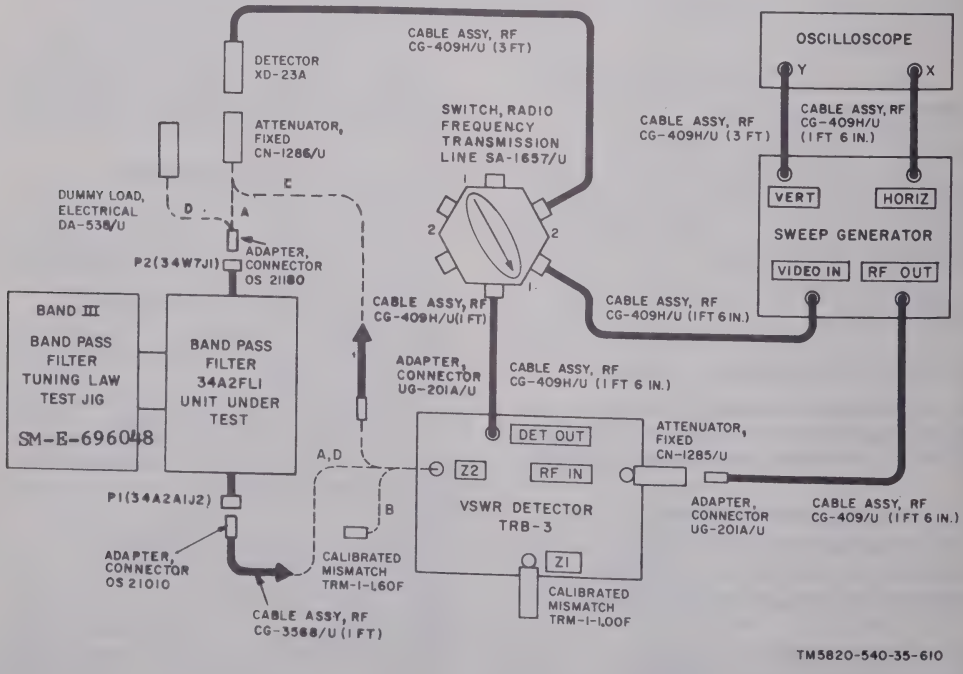


Figure 4–357. Bandpass filter 34A2FL1 bandwidth, vswr and insertion loss check, test setup.

(*d*) Adjust the oscilloscope controls for a convenient display.

(*e*) Calibrate the oscilloscope for a vswr of 1.6:1 between 725 and 1030 MHz.

(*f*) Connect the test equipment as shown in figure 4–357.

(*g*) Tune the unit under test through its frequency range and note that the peak of the response remains below the 1.6:1 vswr calibration line.

(3) *Insertion loss check.*

(*a*) Connect the test equipment as shown in C, figure 4–357.

(*b*) Set the coaxial switch to position 2.

(*c*) Adjust the sweep generator controls to provide maximum output with a sweep between 700 and 1050 MHz.

(*d*) Adjust the oscilloscope controls for a convenient display.

(*e*) Decrease the sweep generator output level by 2 db and mark the indicated level on the oscilloscope graticule.

(*f*) Reset the sweep generator output level to maximum.

(*g*) Connect the test equipment as shown in A, figure 4–357.

(*h*) Tune the unit under test through its frequency range and check that the insertion loss does not exceed 2 db.

(4) *Rejection check.*

(*a*) Connect the test equipment as shown in A, figure 4–358.

(*b*) Set the variable attenuators to 35 db.

(*c*) Tune the signal generator to 725 MHz as indicated on the frequency meter. Modulate this signal with 100 Hz at a level of 30 percent.

(*d*) Adjust the vswr indicator and the signal generator output level for a convenient indication on the vswr indicator and record this level.

(*e*) Connect the test equipment as shown in B, figure 4–358.

(*f*) Set the unit under test to the 725-MHz calibrated space of the test jig hinged gage.

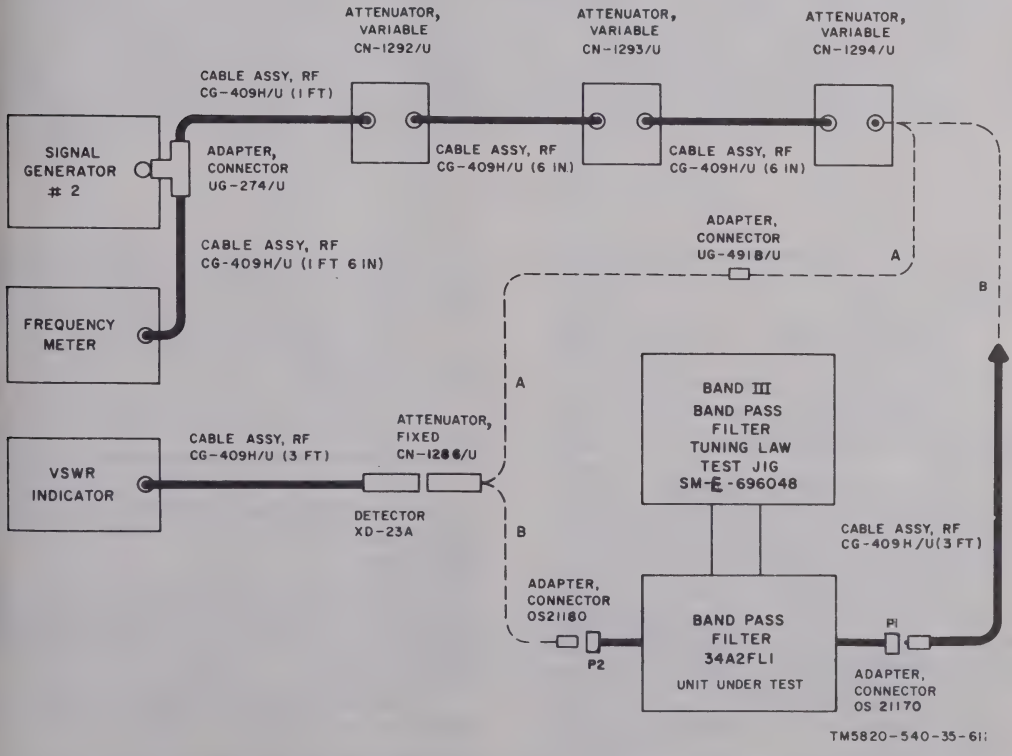


Figure 4–358. Bandpass filter 34A2FL1 rejection check, test setup.

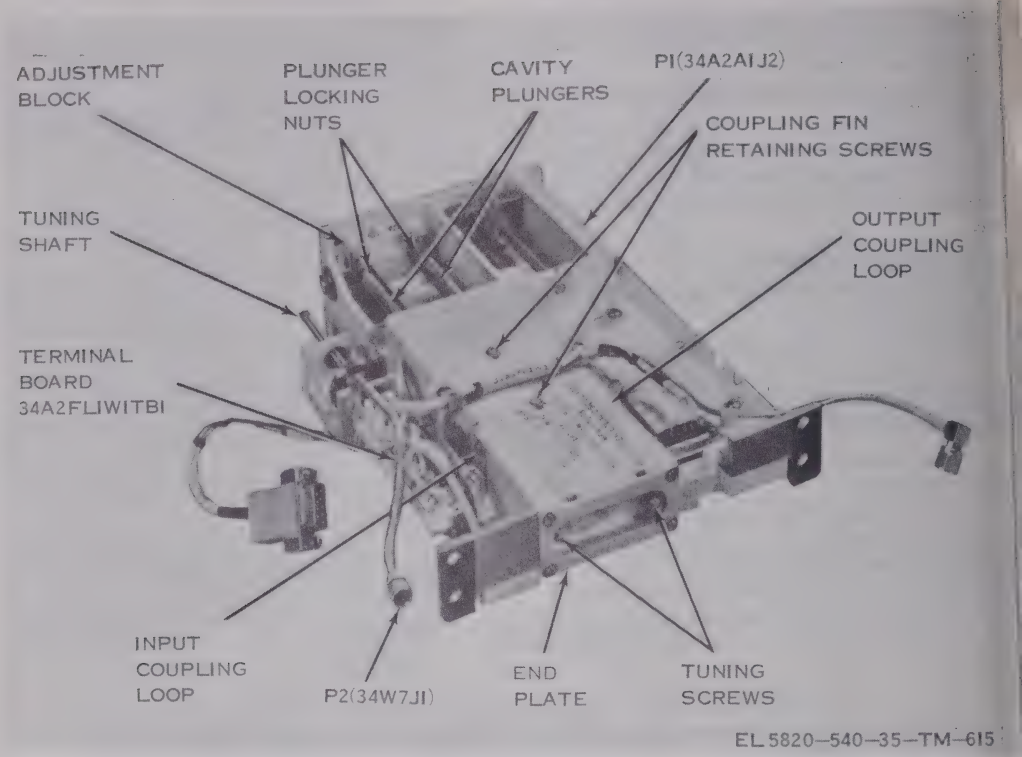


Figure 4–359. Bandpass filter 34A2FL1, bottom view.

(*g*) Tune the signal generator frequency to 50 MHz above that of the test jig as indicated on the frequency meter.

(*h*) Set the variable attenuators to 0 db.

(*i*) The vswr indicator reading should be less than that recorded in step (*d*) above.

(*j*) Repeat steps (*g*) and (*i*) above for a signal generator frequency 50 MHz below that of the test jig.

(*k*) Repeat steps (*f*) through (*j*) above for test jig frequencies of 880 and 1030 MHz.

c. Alignment Procedures.

(1) *Initial adjustment.*

(*a*) Remove the end plate (fig. 4–359) from the unit under test. Adjust the input and output coupling loops (fig. 4–359) to the mechanical center of their tuning range.

(*b*) Connect the test equipment as shown in B, figure 4–357.

(*c*) Set the coaxial switch to position 1.

(*d*) Set the sweep generator for maximum output and calibrate the oscilloscope for 1.6:1 vswr between 725 MHz and 1030 MHz.

(*e*) Connect the test equipment as shown in A, figure 4–357.

(*f*) Set the coaxial switch to position 2.

(*g*) Set the unit under test to the 1030 MHz calibrated space of the test jig hinged gage.

(*h*) Set the sweep generator center frequency to approximately 1030 MHz and adjust the sweep width for a convenient display of the response curve.

(*i*) Loosen the two plunger locking nuts (fig. 4–359) and independently adjust the plungers to center the response on the 1030-MHz marker. Tighten the locking nuts.

(*j*) Set the sweep generator center frequency to approximately 880 MHz.

(*k*) Set the unit under test to the 880 MHz calibrated space of the test jig hinged gage.

(*l*) Not used.

(*m*) Set the coaxial switch to position 1 and connect the test equipment as shown in D, figure 4–357.

(*n*) Adjust the input and output coupling loops and the coupling fin for minimum vswr (less than 1.6:1).

NOTE

The coupling fin is adjusted by loosening the coupling fin retaining screws and sliding the retaining screws to the desired position. Do not remove the retaining screws.

(*o*) Repeat steps (*g*) and (*h*) above and measure the vswr. If necessary, slightly readjust the input and output coupling loops and the coupling fin for a compromise to meet the requirements of 1.6:1 maximum vswr at 1030 MHz and 880 MHz.

(*p*) Simultaneously tune the sweep generator center frequency and the unit under test from 1030 MHz to 880 MHz. The vswr should not exceed 1.6:1.

(2) *Final adjustments.*

(*a*) Install the end plate on the unit under test and connect the test equipment as shown in A, figure 4–357.

(*b*) Set the unit under test to the 725 MHz calibrated space of the test jig hinged gage.

(*c*) Set the sweep generator center frequency to approximately 725 MHz.

(*d*) Set the coaxial switch to position 2.

(*e*) Adjust the two end plate tuning screws to center the response on the 725-MHz markers.

(*f*) Set the sweep generator center frequency to approximately 880 MHz.

(*g*) Set the unit under test to the 880 MHz calibrated space of the test jig hinged gage.

(*h*) If necessary, slightly readjust the input and output coupling loops to center the response on the 880-MHz marker.

(*i*) Set the sweep generator center frequency to approximately 1030 MHz.

(*j*) Set the unit under test to the 1030-MHz calibrated space of the test jig hinged gage. If necessary, slightly readjust the input and output coupling loops to center the response on the 1030-MHz marker.

(*k*) Repeat (*i*) and (*j*) above for best compromise of response centering.

(*l*) Not used.

(*m*) Check the bandwidth and vswr as described in *b*(1) and (2) above.

4–181. RF Power Monitor 34A3

RF power monitor 34A3 is identical to RF power monitor 33A3. For test procedures, refer to paragraph 4–128.

4–182. Control-Indicator 34A4

Control-indicator 34A4 is similar to control-indicator 38A2. For test and troubleshooting procedures, refer to paragraph 4–162.

4–183. Signal Level Control-Monitor 34A5

Signal level control-monitor 34A5 is identical to signal level control-monitor 33A5. For test and troubleshooting procedures, refer to paragraph 4–130.

4–184. Radio Signal Distribution Panel 34A6

Radio signal distribution panel 34A6 is similar to radio signal distribution panel 33A6. Refer to paragraph 4–131.

4–185. Frequency Mixer Stage 34A7

a. Test Equipment and Material Required.

Equipment	*Common name*
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory Kit
Oscilloscope AN/USM–281	Oscilloscope
Generator, Sweep SG–888	Sweep Generator
Generator, Signal SG–340A/G.	Signal generator
Voltmeter, Vector Hewlett-Packard 8405A.	Vector voltmeter
Accessory Kit, Vector Voltmeter Hewlett-Packard 11570A.	50-ohms loads and 50-ohm 'T's
Frequency Meter AN/USM–159.	Frequency meter
Generator, Thermal Noise SG–427/U and Power Supply	High frequency noise generator.
Unit IF Amplifier, General Radio Model 1216–A.	Unit IF amplifier
Multimeter TS–352B/U	Multimeter
Voltmeter, Digital AN/GSM–64.	Digital voltmeter (DVM)
Vswr Bridge ANZAC RB–3	Vswr bridge RB–3
Wattmeter AN/URM–98	Power meter
Frequency Mixer Stage Test Jig SM–E–696028.	Mixer test jig
Amplifier, GP LA–2300–43	Low noise IF amplifier LA–2300–43
Wideband RF Amplifier SM–C–696030	Wideband RF amplifier SM–C–696030
30–MHz Gaussian Filter SM–A–698149	
Filter, Low Pass Telinic TLC–1000–5EF.	Filter TLC–1000–5EF

Equipment	*Common name*
Filter, Low Pass Telonic TLC–290–5EF.	Filter TLC–290–5EF
Detector, RF XD–23A	Detector XD–23A
Adapter-Connector 874–GBJL (3 required).	
Adapter-Connector 874–QBJA	
Adapter-Connector 874–QBPA	
Adapter-Connector 874–QNJL (2 required).	
Adapter-Connector OMNI Spectra 21190	Adapter-connector OS21190
Adapter-Connector Omni Spectra 21030	Adapter-connector OS21030
Adapter-Connector Omni Spectra 21200	Adapter-connector OS21200

b. Test Procedures.

NOTE

It is recommended that the following tests be performed in an RFI free environment.

(1) *RF input VSWR and local oscillator level metering checks.*

(*a*) Connect the test equipment as shown in figure 4–360A.

(*b*) Using internal markers adjust sweep generator SWEEP WIDTH controls for a flat response over the frequency range of 695 to 1000 MHz. Set ATTENUATOR control to 0 db, and adjust RF VERNIER control on the sweep generator to obtain a −13 dbm reading. Set ATTENUATOR control to 30 db.

(*c*) Connect the test equipment as shown as shown in figure 4–360B, and adjust oscilloscope for a suitable reference reading. This shall be the 2.0:1 vswr reference.

(*d*) Connect the test equipment as shown in figure 4–360C.

(*e*) Check that the vswr over the frequency range of 695 to 1000 MHz is less than the response obtained in (c) above, (vswr better than 2.0:1).

(*f*) Connect the test equipment as shown in figure 4–360D.

(*g*) Set the signal generator at 725 MHz and adjust its output level for a +6 dbm indication on the power meter.

(*h*) Connect the test equipment as shown in figure 4–360E. The digital voltmeter indication should be greater than 135 mv.

(2) *Conversion gain and image rejection checks.*

(*a*) Connect the equipment as shown in figure 4–361A.

(*b*) Set the sweep generator to 695 MHz (CW) as indicated on the frequency meter and adjust the RF VERNIER for a 0 dbm indication on the power meter.

(*c*) Disconnect the frequency meter from the VSWR bridge and connect it to the output of the signal generator. Set signal generator at a frequency 30 MHz higher than the sweep generator frequency in (*b*) above (725 MHz). Reconnect the frequency meter to the VSWR bridge.

(*d*) Connect the power meter to the signal generator as shown in figure 4–361B. Adjust signal generator output level for a +6 dbm indication on the power meter.

(*e*) Connect the test equipment as shown in figure 4–361C.

(*f*) Note the vector voltmeter indication. Subtract this indication from −30 dbm (RF input at J1 of unit under test). The result is the conversion gain which should be 14 ±4 db.

(*g*) Connect the test equipment as shown in figure 4–361A. Set the sweep generator at a frequency 60 MHz higher than in (*b*) above (755 MHz) and adjust the RF VERNIER for a 0 dbm indication on the power meter.

(*h*) Note the vector voltmeter indication. Substract this indication from the indication obtained in (*f*) above to obtain the image rejection. This shall be a minimum of 5 db.

(*i*) Repeat steps (b) to (h) above starting with the sweep generator frequency of 850 MHz and 1000 MHz.

(3) *Noise figure check.*

(*a*) Connect the test equipment as shown in figure 4–362A.

(*b*) Set signal generator to 725 MHz as indicated on the frequency meter. Set the variable attenuator to 0.

(*c*) Connect the test equipment as shown in figure 4–362B.

(*d*) Set the variable attenuator to 0 and adjust the signal generator output level for a +6 dbm indication on the power meter.

(*e*) Connect the test equipment as shown in figure 4–362C.

(*f*) Note the meter indication on the unit IF amplifier.

(*g*) Fire the noise generator and set the discharge current to 200 ma. Adjust the variable attenuator to obtain the same meter indication on the unit IF amplifier as noted in (*f*) above.

(*h*) The attenuation obtained in (*g*) above is the Y-factor. Using this Y factor calculate the noise figure using figure 4–363. From this noise figure subtract 6 db (the two 3-db attenuators at

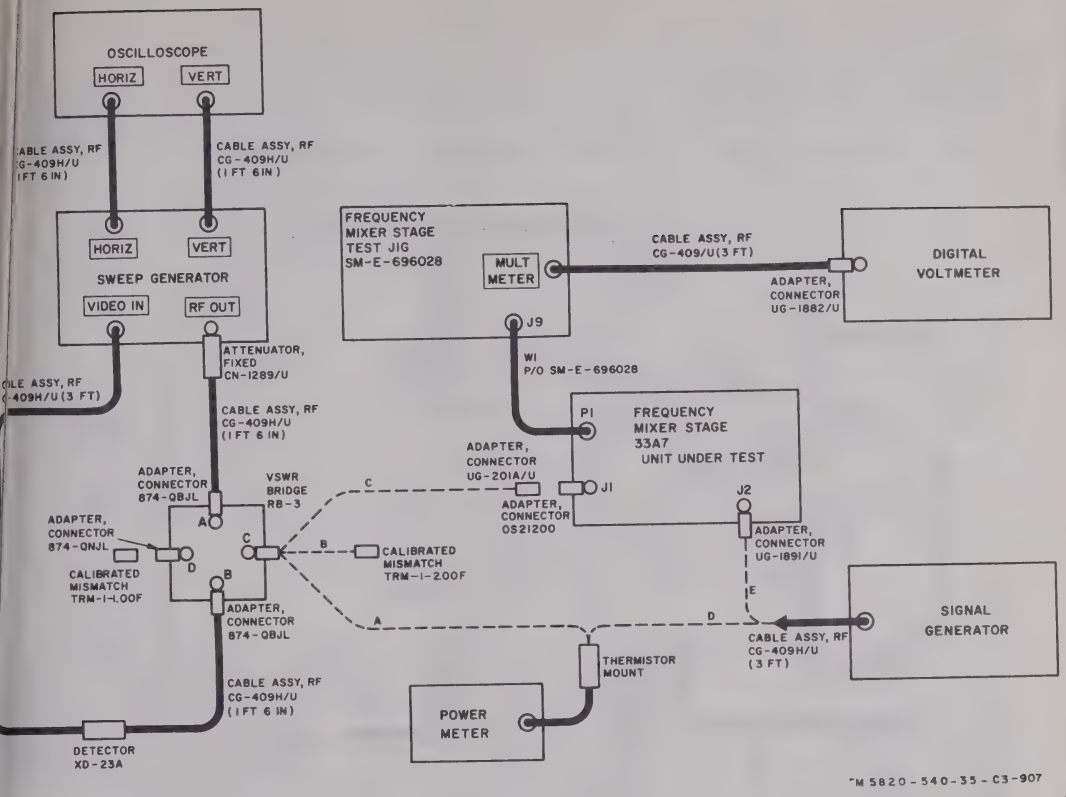


Figure 4–360. Frequency mixer stage 34A7, RF input vswr and local oscillator level metering.

). The result value is the true noise figure and ıould not exceed 4.5 db.

NOTE

Attenuation versus frequency data on the two 3-db calibrated attenuators should be used in the Y factor calculation.

(*i*) Adjust frequency of signal generator to 1030 MHz and repeat steps (*b*) through (*h*) above.

c. Troubleshooting (fig. 8–8).

Symptom	*Probable cause*	*Checks and corrective measures*
No 30 MHz IF output (*b*(2) above)	*a.* Faulty RF amplifier 34A7A1AR1 (fig. 4–364).	*a.* Check RF amplifier input vswr (*b*(1) above). If outside limits, replace faulty 34A7A1AR1.
	b. Faulty local oscillator input circuits.	*b.* Check local oscillator input vswr; if higher than 3.0:1, check for broken connection in the rigid cable. Replace faulty I/C monitor-power 34A7A1A1.
	c. Broken wires unsoldered joints, loose connections.	*c.* Visually check for open connections.
	d. Both balanced mixers faulty.	*d.* Replace both balanced mixers 34A7A1A2 and 34A7A1A3.
Low conversion gain (*b*(2) above).	One faulty balanced mixer.	Check image rejection (*b*(2) above). If image level high check for faulty mixer as follows. Apply a ground to the junction of L1–A and C1 while observing the 30 MHz output (*b*(2)(*f*)). If a 5–6 db drop in level is observed, 34A7A7A3 is faulty. If no drop in

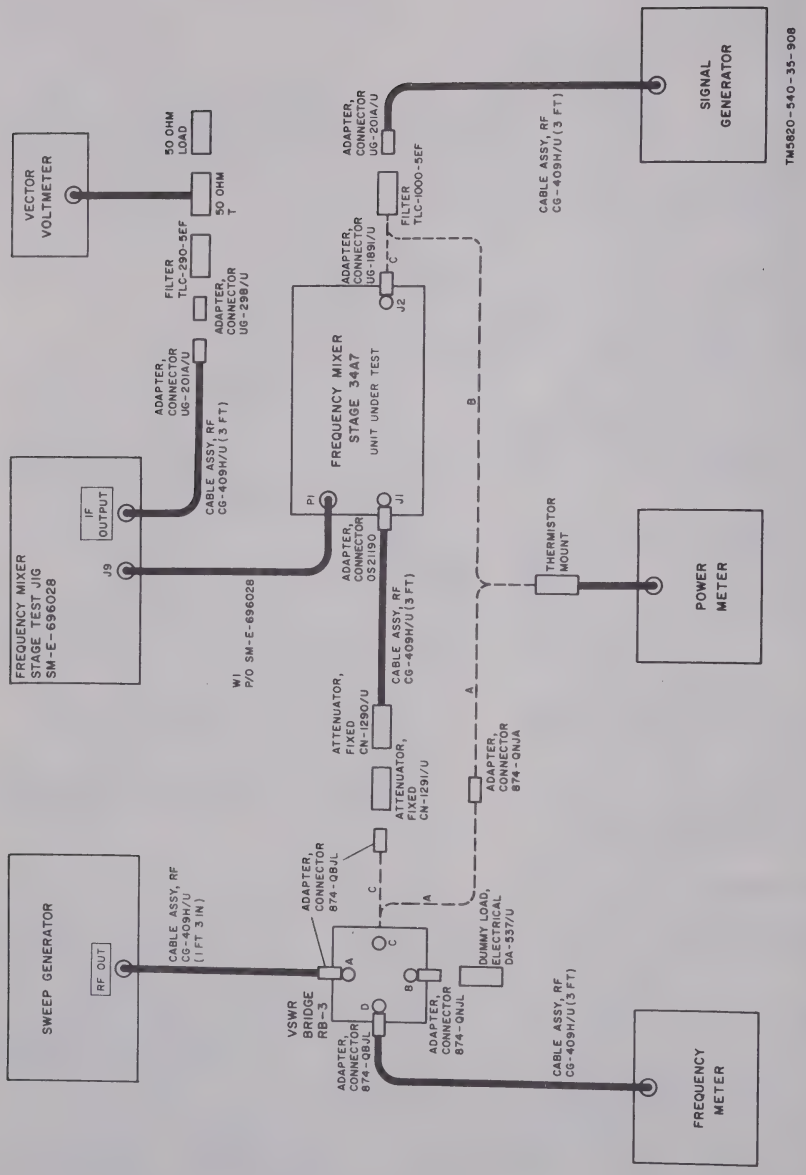


Figure 4-361. Frequency mixer stage 34A7, conversion gain and image, rejection check, test setup.

Symptom	*Probable cause*	*Checks and corrective measures*
		level is observed then 34A7A1A2 is faulty. Apply a ground to the junction of L1–B and C2 and confirm the faulty mixer.
3. High noise figure across the band (*b*(2) above).	Faulty RF amplifier 34A7A1AR1.	Replace faulty 34A7A1AR1 module.
4. No local oscillator metering voltage.	Faulty I/C monitor-power 34A7A1A1.	Replace faulty 34A7A1A1 module.

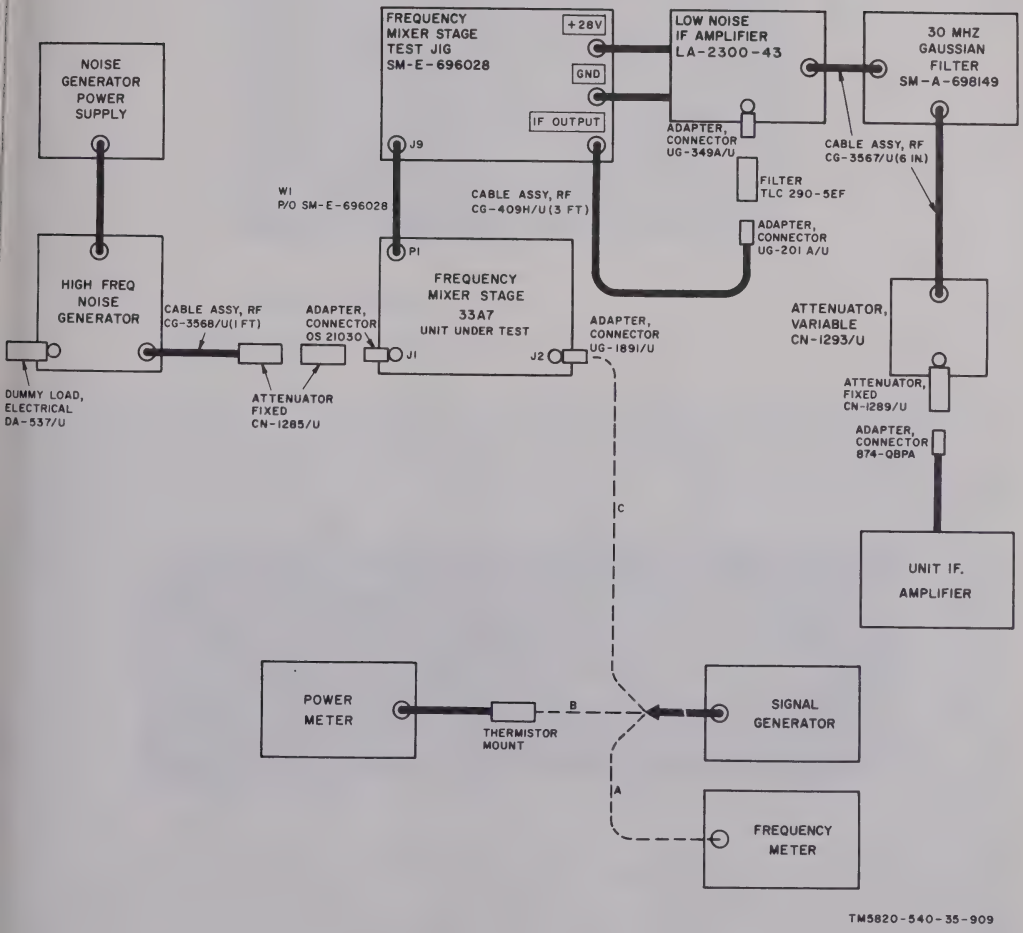


Figure 4–362. Frequency mixer stage 34A7, noise figure measurement, test setup.

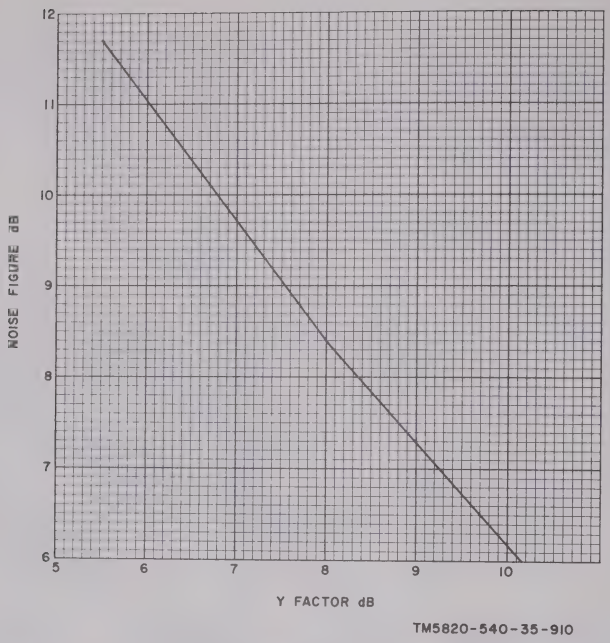


Figure 4-363. Y-factor to noise figure conversion chart for frequency mixer stage 34A7.

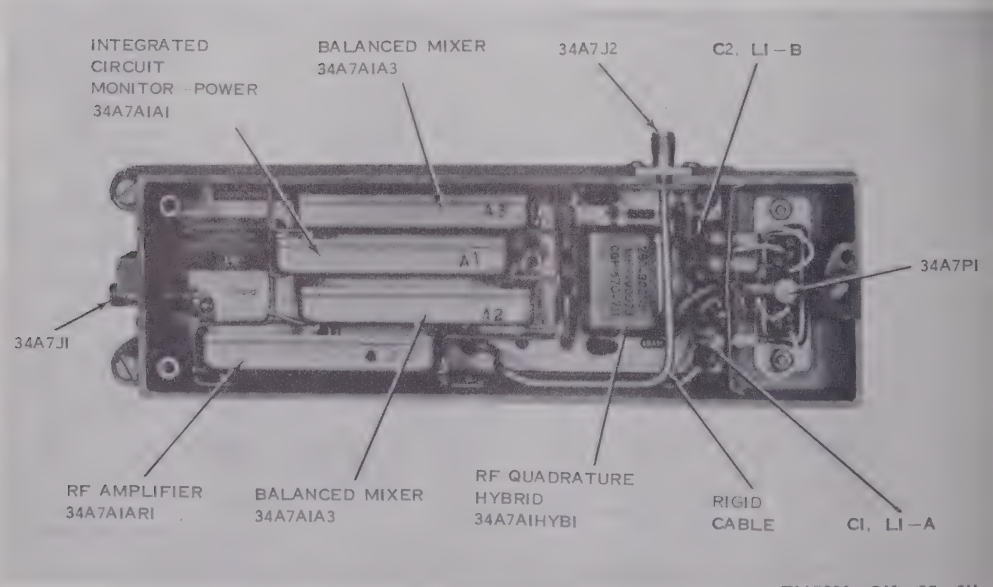


Figure 4-364. Frequency mixer stage 34A7 with cover removed.

(Next printed page is 4-459)

Figures 4-365 through 4-372 are deleted.

4–186. Intermediate Frequency Amplifier 34AR1

Intermediate frequency amplifier 34AR1 is identical to intermediate frequency amplifier 33AR1. For test and troubleshooting procedures, refer to paragraph 4–133.

4–187. Amplifier-Filter 34AR1A1

Amplifier-filter 34AR1A1 is identical to amplifier-filter 33AR1A1. For test procedures, refer to paragraph 4–134.

4–188. Low Pass Filter 34FL1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Oscilloscope AN/USM–281	Oscilloscope
Indicator, Standing Wave Ratio AN/UPM–108.	Vswr indicator
Generator, Signal SG–340A/G	Signal generator No. 2
Generator, Signal SG–644/U	Signal generator No. 3
Generator, Sweep SG–888	Sweep generator
Detector, RF XD–23A	Detector XD–23A
Adapter-Connector Omni Spectra 21030.	Adapter, connector OS21030
Adapter-Connector Omni Spectra 21190.	Adapter-connector OS21190
Adapter-Connector Omni Spectra 21200.	Adapter-connector OS21200

b. Test Procedures.

(1) *Vswr check.*

(*a*) Connect the test equipment as shown in A, figure 4–373.

(*b*) Adjust the sweep generator controls to provide a sweep between 695 and 1000 MHz.

(*c*) Adjust the oscilloscope controls and the sweep generator output level control to obtain a convenient display on the oscilloscope.

(*d*) Mark the resultant display on the graticule of the oscilloscope. This display represents a vswr of 1.20:1.

(*e*) Connect the test equipment as shown in B, figure 4–373.

(*f*) The vswr displayed on the oscilloscope should not exceed the line marked in (*d*) above.

(*g*) Reverse the connections at the input and output of the unit under test.

(*h*) The vswr displayed on the oscilloscope should not exceed the line marked in (*d*) above.

(2) *Insertion loss check.*

(*a*) Connect the test equipment as shown in A, figure 4–374.

(*b*) Turn the variable attenuator to 0.

(*c*) Set signal generator No. 2 to 695 MHz at maximum output, modulated with 1.0 kHz.

(*d*) Adjust the vswr indicator for a convenient indication and record the indication obtained.

(*e*) Connect the test equipment as shown in B, figure 4–374.

(*f*) Adjust the variable attenuator to ob-

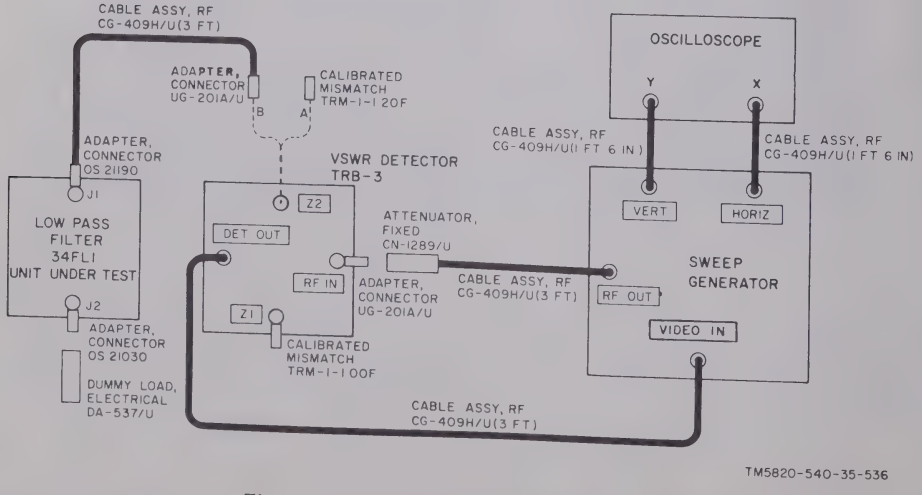


Figure 4–373. Low-pass filter 34FL1 vswr test setup.

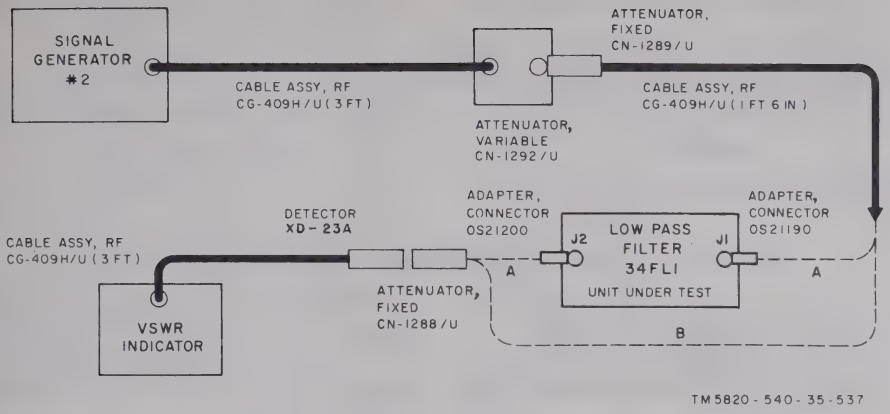


Figure 4–374. Low-pass filter 34FL1 insertion loss, test setup.

tain the indication recorded in (*d*) above. The attenuator setting should not exceed 0.3 db.

(*g*) Connect the test equipment as shown n A, figure 4–374.

(*h*) Turn the variable attenuator to 0.

(*i*) Set signal generator No. 2 to 1000 MHz at maximum output, modulated with 1.0 kHz.

(*j*) Adjust the vswr indicator for a convenient indication and record the indication obtained.

(*k*) Connect the test equipment as shown n B, figure 4–374.

(*l*) Not used.

(*m*) Adjust the variable attenuator to obtain the indication recorded in (*j*) above. The attenuator setting should not exceed 0.3 db.

(3) *Insertion loss outside the passband check.*

(*a*) Connect the test equipment as shown n A, figure 4–375.

(*b*) Set signal generator No. 3 to 2085 MHz modulated with 1.0 kHz. Adjust the output attenuator for 35 db.

(*c*) Adjust the vswr indicator for a convenient indication and record the indication obtained.

(*d*) Connect the test equipment as shown in B, figure 4–375.

(*e*) Turn the signal generator output attenuator to 0 db. The vswr indicator reading should be less than that recorded in (*c*) above.

(*f*) Connect the test equipment as shown in A, figure 4–375.

(*g*) Set signal generator No. 3 to 2350 MHz modulated with 1.0 kHz. Adjust the output attenuator for 35 db.

(*h*) Adjust the vswr indicator for a convenient indication and record the indication obtained.

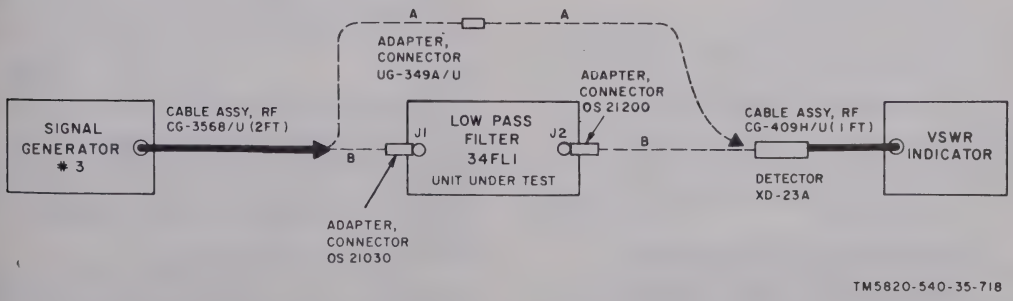


Figure 4–375. Low-pass filter 34FL1 insertion loss outside the passband, test setup.

(*i*) Connect the test equipment as shown in B, figure 4-375.

(*j*) Turn the signal generator output attenuator to 0 db. The vswr indicator reading should be less than that recorded in (*h*) above.

NOTE

This unit is expendable. If any of the above tests indicate that the unit is defective, discard the unit.

4-189. Power Supply 34PS1

Deleted.

Section IX. RADIO SET ALIGNMENT PROCEDURES—BAND III

4-190. Transmitter Radio T-983(P)/GRC-103(V) and Amplifier-Frequency Multiplier AM-4322/GRC-103(V) (Transmitter Fixed and RF Heads) Tests and Alignment

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/GRM-95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V).	Accessory kit
Voltmeter Electronic ME-30A/U.	VTVM
Signal Generator AN/USM-205.	Wide range oscillator
Generator, Signal SG-340A/G	Signal generator No. 2
Selective Voltmeter AN/USM-306.	Level meter
Wattmeter AN/URM-120	Wattmeter
Wattmeter AN/URM-98	Power meter
Frequency Meter AN/USM-159.	Frequency meter
Multimeter TS-352B/U	Multimeter
Wave Analyzer Bruel and Kjoer 2107.	Wave analyzer
Adapter-Connector UG-564A/U.	
Cable Assembly, Special Purpose, Electrical CX-10762/GRC-103(V).	
Cable Assembly, Special Purpose, Electrical CMC 217-800010.	
Trombone Line General Radio 874-LTL.	Trombone line 874-LTL
Short Circuit Plug Microlabs TS-5MC	Short circuit plug
Adapter-Connector 874-QNJL (2 required).	

b. Test Procedures.

(1) *Preliminary operational checks.*

(*a*) Connect the test equipment as shown in A, figure 4-376.

(*b*) Set the voltage control on the power supply (part of the accessory kit) to 115v ac.

(*c*) Set the unit under test AC POWER switch to ON/RESET. Observe the following on the unit under test:

1. Buzzer may sound; press BUZZER OFF switch to silence the buzzer.

2. Blower should operate.

3. AC POWER lamp should light.

4. If the SYNC alarm lamp lights, it should extinguish within 10 seconds.

5. LOW POWER alarm lamp should light.

(*d*) Check the unit under test meter indications at the following meter selector switch positions:

Switch position	Typical indication
12V DC	In the green band
28V DC	In the green band
600V DC	In the green band
OSC	20% to 90% full scale

(*e*) On the unit under test, set the XMTR CHANNEL and XMTR TUNE controls to channel 990.

(*f*) Check the unit under test meter indications at the following meter selector switch positions:

Switch position	Typical indication
DOUBLER	20% to 90% of full scale
MULT	20% to 90% of full scale

(*g*) Set the meter selector switch to DRIVER. Tune the XMTR TUNE control for maximum meter indication. The unit under test meter should indicate 20 to 90 percent of full scale.

(*h*) Set the meter selector switch to PWR OUT. Fine tune the XMTR TUNE control for maximum meter indication. The unit under test

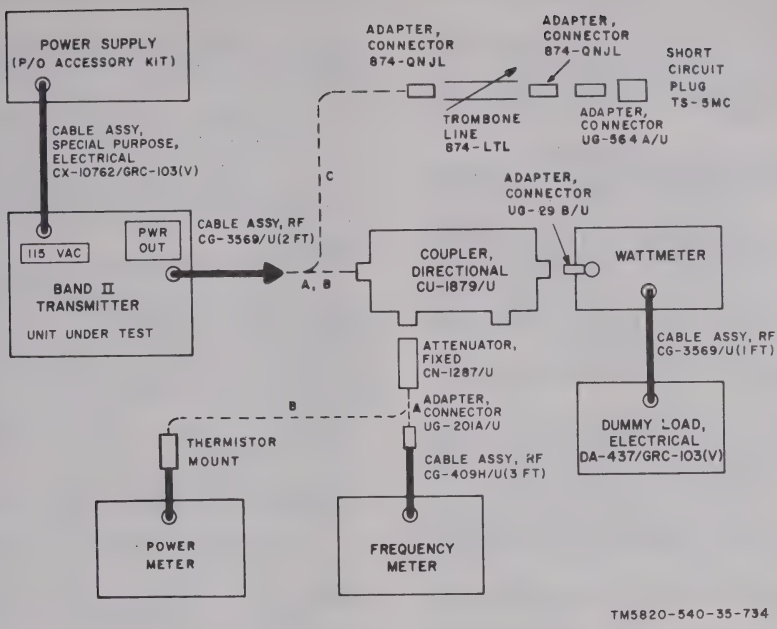


Figure 4–376. Band III transmitter operational check, test setup.

ter should indicate not less than 40 percent of scale. If the indication is greater than 100 cent of full scale, observe the wattmeter for ximum indication.

(*i*) The unit under test LOW POWER ıp should go out and the buzzer should sound. ss the BUZZER OFF pushbutton to silence buzzer.

NOTE

The unit under test XMTR TUNE control can be readjusted slightly (not to exceed ½-inch movement on the XMTR TUNE tape) to peak the meter indications.

(*j*) Set the AC POWER switch to OFF.

(*k*) Remove the transmitter RF head from e transmitter case and use extension cable -12028 (1 ft 3 in.) to reestablish connections.

(*l*) Not used.

(*m*) Set the AC POWER switch to ON/ ESET.

(*n*) Set the meter selector switch to PWR JT and observe the unit under test meter. Readjust the PWR OUT PEAK control for peak power as in (*h*) above.

(*o*) Locate and remove the access door at the right-hand side of the transmitter RF head dust cover (fig. 1–3, TM 11–5820–540–12) to allow access to the test points on the voltage regulator assembly 38AR1A1A1.

(*p*) Use the multimeter to check the heater voltages as shown below and record the indications.

Heater voltage	Connect multimeter between	Voltage reading (v dc)	Multimeter range
Driver amplifier	TP1(−) and TP3(+).	6.0 to 6.4	10 vdc
Output amplifier	TP2(−) and TP4(+).	6.0 to 6.4	

(*q*) Set the AC POWER switch to OFF and replace the access door in the dust cover. Reinstall the transmitter RF head in the transmitter case.

(*r*) Set the AC POWER switch to ON.

(*s*) Set the meter selector switch to PWR OUT. Record the unit under test meter indication.

(*t*) Set the meter selector switch to REFL

PWR the unit under test meter indication should be less than 10 percent of full scale.

(*u*) Temporarily disconnect the cable from the unit under test PWR OUT connector; the meter should indicate a level nearly equal to that obtained in (*s*) above.

(2) *RF output power measurement.*

(*a*) Use the test setup shown in A, figure 4–376.

(*b*) On the unit under test set the XMTR CHANNEL and XMTR TUNE controls to channel 990.

(c) Tune the unit under test to peak power as described in (1)(*g*) and (*h*) above.

(*d*) Check the wattmeter indication; it should be at least 20 watts.

(*e*) Set the voltage control on the power supply (part of the accessory kit) to 105v ac. The wattmeter should indicate at least 20 watts.

(*f*) Set the voltage control on the power supply to 125v ac. The wattmeter should indicate at least 20 watts.

(*g*) Reset the voltage control on the power supply to 115v ac.

(*h*) Repeat (*b*) through (*g*) above for every test channel listed below.

Channel	Frequency (MHz)
1000	700
1080	740
1160	780
1240	820
1279	839.5
1280	840
1320	860
1400	900
1480	940
1540	970
1600	1000

(*i*) Disconnect the power supply from the 60-Hz supply and connect it to a 400-Hz supply.

(*j*) Repeat (*b*) through (*g*) above for every test channel listed above. The wattmeter should indicate at least 20 watts.

(*k*) Reconnect the power supply to the 60-Hz supply.

(3) *Low-power alarm operating level measurements.*

(*a*) Use the test setup shown in A, figure 4–376.

(*b*) Tune the unit under test to channel 990 and tune for peak output power as described in (1)(*g*) and (*h*) above.

(*c*) Reduce the output power of the unit under test by slowly detuning the XMTR TUNE control.

(*d*) Note the power level on the wattmeter at which the LOW POWER alarm lamp lights. It should be between 2.0w and 5.0w. The buzzer should sound; press the BUZZER OFF pushbutton to silence the buzzer. Note the power meter indication.

(*e*) Slowly restore the output power by retuning the transmitter. Note the power level, indicated on the power meter, at which the LOW POWER lamp goes out and the buzzer sounds. Silence the buzzer. The increased power to clear the alarm should be between 3 and 5 db; the power level indicated on the wattmeter should not exceed 10 watts.

(*f*) Repeat (*b*) through (*e*) above for all test channels listed in the chart in (2)(*h*) above.

(4) *Output tube dissipation check.*

(*a*) Use the test setup shown in B, figure 4–376.

(*b*) Set the voltage control on the power supply to 125v ac.

(*c*) On the unit under test, set the XMTR CHANNEL and XMTR TUNE controls to channel 990 and tune for peak output power as described in (1)(*g*) and (*h*) above. Record the output power as indicated on the wattmeter.

(*d*) Connect the test equipment as shown in C, figure 4–376. Set the meter selector switch to DRIVER. Vary the length of the trombone line for maximum meter indication and leave the transmitter on for 15 minutes.

(*e*) Without changing the length of the trombone line, remove the short circuit plug. The DRIVER meter indication should decrease. Leave the transmitter on for another 15 minutes.

(*f*) Reconnect the cable to the directional coupler (A, fig. 4–376). The wattmeter should indicate within 2 watts of the level noted in (*c*) above.

(*g*) On the unit under test set the XMTR CHANNEL control to channel 1279 and the XMTR TUNE control to channel 990. (This effectively removes the transmitter drive.)

(*h*) Set the unit under test meter selector switch to MULT. The meter should indicate less than 10 percent of full scale.

(*i*) Set the nuit under test meter selector switch to DRIVER. The meter should indicate less than 15 percent of full scale.

(*j*) Leave the unit under test on for 30 inutes.

(*k*) Set the XMTR CHANNEL and XMTR UNE controls to channel 990 and tune for peak utput power as described in (1)(*g*) and (*h*) bove. The wattmeter should indicate within 2 atts of the level recorded in (*c*) above.

(5) *Transmitter frequency check.*

(*a*) Use the test setup as shown in A, gure 4–376.

(*b*) Set the voltage control on the power upply for 115v ac.

(*c*) On the unit under test set the XMTR HANNEL and XMTR TUNE to channel 990 nd tune for peak output power as described in 1)(*g*) and (*h*) above. The counter should indiate 695 MHz + 13.9 kHz.

(*d*) Repeat (*c*) above for all test channels sted in (2)(*h*) above. The frequency accuracy nall be within 0.002 percent of nominal freuency (20 Hz per MHz).

(6) *Frequency deviation measurements.*

(*a*) *Initial setup.* Connect the test equipent as shown in A, figure 4–377.

(*b*) *24-channel deviation measurement.*

1. Set transmitter test facility switch S1 to ON and switch S20 to 30 MHZ DISCR.

2. On unit under test, set the meter selector switch to 24 CH PCM and the INPUT control to midpoint.

3. On the unit under test, set the XMTR CHANNEL and XMTR TUNE controls to channel 1010 and tune for peak output power as described in (1)(*g*) and (*h*) above.

4. Adjust the wide range oscillator to 10 kHz and adjust the output level for a transmitter meter indication of 50 percent of full scale.

5. Tune signal generator No. 2 to 675 MHz; set the signal generator attenuator to 0 dbm.

6. Observe test facility meter M1 and fine tune the signal generator for a peak indication. Adjust the attenuator on the signal generator to maintain M1 indication at 50 percent full scale. Tune the signal generator for a midscale indication on test facility meter M2. The deviation as indicated by the unterminated VTVM should be between 260 and 386 mv rms (1 mv rms = 1 kHz peak deviation).

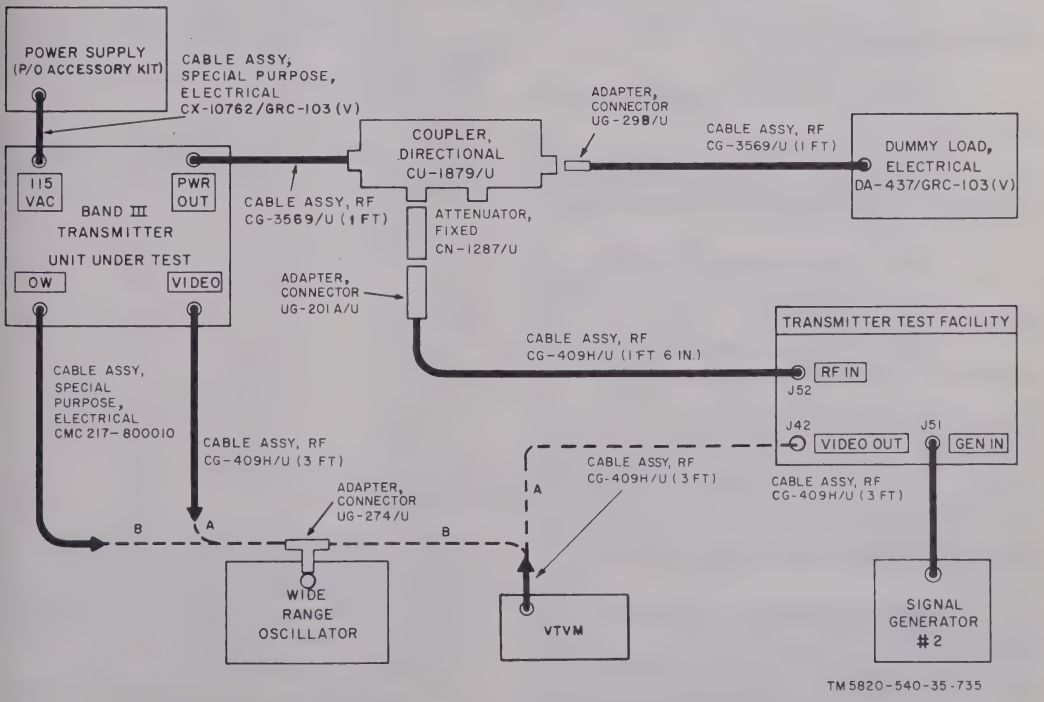


Figure 4–377. Band III transmitter frequency deviation measurements, test setup.

(*c*) *12-channel deviation measurement.* Using the setup given in (*b*) above, set the unit under test meter switch to 12 CH PCM and adjust the INPUT control for a 50 percent of full scale indication. The deviation as indicated by the unterminated VTVM should be between 156 and 232 mv rms.

(*d*) *Order wire deviation measurement.*

1. Connect the wide range oscillator and VTVM to the unit under test OW connector as shown in B, figure 4–377.

2. Adjust the wide range oscillator output for a —10 dbm indication on the VTVM.

3. Reconnect the VTVM to test facility connector J42. The VTVM should indicate between 39 and 58 mv rms (1 mv rms = 1 kHz peak deviation).

(*e*) Repeat (*b*) through (*d*) above for the test channels listed in the chart below:

Channel	Signal generator frequency (MHz)
1100	720
1250	795
1600	970

(7) *Frequency response measurements and spurious outputs in video band.*

(*a*) *Initial calibration.*

1. Connect the test equipment as shown in A, figure 4–378.

2. Set the unit under test XMTR CHANNEL and XMTR TUNE controls to channel 1030 and tune for peak output power as described in (1)(*g*) and (*h*) above.

3. Set the coaxial switch to position 1.

4. Tune signal generator No. 2 to 685 MHz at an output of 0 dbm.

5. Set transmitter test facility switch S1 to ON and switch S20 to 30 MHZ DISCR.

6. Observe test facility meter M1 and fine tune the signal generator for a peak indication. Adjust the signal generator attenuator to maintain meter M1 at 50 percent of full scale, then tune until a 50 percent of full scale indication is obtained on test facility meter M2. (Both meters M1 and M2 should indicate 50 percent of full scale.)

7. Set the unit under test meter selector switch to FDM.

8. Tune the wide range oscillator to 10 kHz with an output level of 350 mv rms. Adjust the unit under test INPUT control for 65 percent of full scale indication on the unit under test meter (approximately 100-kHz peak deviation).

9. Check the output signal-to-noise ratio as described below. The output signal-to-noise ratio should be at least 20 db at 960 kHz.

(a) Tune the wide range oscillator to 960 kHz.

(b) Set the frequency of level meter to 960 kHz. Record the level meter indication.

(c) Disconnect the wide range oscillator and increase the level meter gain by 20 db. Record the level meter indication; it should not exceed the reading obtained in (b) above (with modulating signal on).

(*b*) *Frequency response tests.*

1. Use the test setup as shown in A, figure 4–378.

2. Tune the wide range oscillator to 10 kHz.

3. Set the frequency of the level meter to 10 kHz. Record the level meter indication.

4. Set the coaxial switch to position 2.

5. Adjust the variable attenuators to obtain a level meter indication within ± 0.1 db of the level obtained in *3* above. Record the variable attenuator settings. This is the reference level.

6. Repeat *2* through *5* above for all frequencies above 10 kHz listed in the chart below and record the attenuator with respect to the reference level (*5* above).

Wide range oscillator (kHz)	Relative attenuation (db), reference 10 kHz		
	Nominal	Minimum	Maximum
0.125	1.0	0	1.5
0.200	0.5	0	1.0
0.250	0.2	0	0.4
1.0	0	−0.1	0.1
10	0		
30	0	−0.2	0.2
60	0.1	0	0.3
120	0.15	0	0.5
240	0.7	0.5	1.5
360	1.5	1.1	2.3
480	2.7	1.9	3.8
600	4.2	3.0	5.9
720	6.0	4.3	8.6
840	8.2	5.8	12.0
960	10.7	7.6	15.0

7. Replace the level meter with the wave analyzer (B, fig. 4–378) and increase the output level of the wide range oscillator by 10 db. Repeat *2* through *5* above for all frequencies below 10 kHz listed in the chart above.

8. Repeat *2* through *7* above for all test channels listed in the chart below.

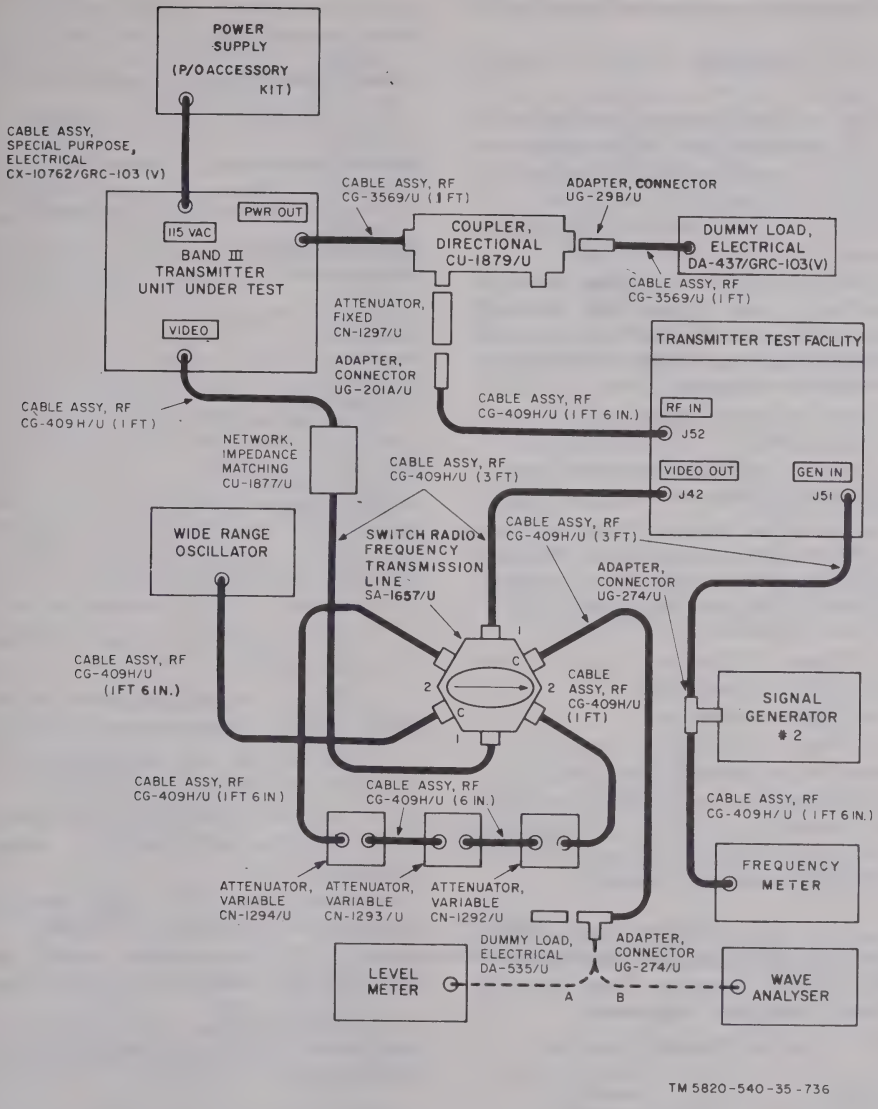


Figure 4–378. Band III transmitter frequency response and spurious interference check, test setup.

Channel	Signal generator (MHz)
79	839.5
80	840
00	995

(*c*) *Spurious outputs in video band test.*

1. Use the test setup shown in A, figure 4–378.

2. Set the unit under test XMTR CHANNEL and XMTR TUNE controls to channel 1060 and tune for peak output power as described in (1) (*g*) and (*h*) above.

3. Set the coaxial switch to position 1.

4. Tune the wide range oscillator to 10 kHz and set the signal generator to 700 mHz at 0 dbm.

5. Set the frequency of the level meter to 10 kHz.

6. On the unit under test, set the meter selector switch to the 12 CHAN PCM position and adjust the INPUT control for a 50 percent of full scale indication on the unit under test meter.

7. Record the output signal indicated on the level meter. This is the reference level.

8. Disconnect the wide range oscillator and search for spurious signals with the level meter from 10 kHz up to 1 MHz. Note the amplitude of the spurious outputs. They should be at least 60 db below the reference.

9. Replace the level meter with the wave analyzer (B, fig. 4–378).

10. Set up the reference level using a 10-kHz signal as described in *3* through *7* above.

11. Disconnect the wide range oscillator and search for spurious signal with the wave analyzer from 200 Hz up to 10 kHz. Note the amplitude of the spurious outputs. They should all be at least 50 db below reference.

12. Repeat *2* through *11* above at test channels 1030, 1279, 1280 and 1590.

(8) *Power consumption check.*

(*a*) Set the voltage control on the power supply (part of the accessory kit) to 115v ac.

(*b*) Tune the unit under test to any channel as described in (1) (*g*) and (*h*) above and note the indication on the power supply ammeter. Indication should be 3.2 amp ± 10 percent.

4–191. Receiver Radio R1329(P)/GRC–103(V) and Amplifier-Converter AM–4318/GRC–103(V) (Receiver Fixed and RF Heads) Tests and Alignment

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Voltmeter, Electronic ME–30A/U.	VTVM
Generator, Signal AN/USM–205.	Wide range oscillator
Generator, Signal SG–340A/G	Signal generator No. 2
Selective Voltmeter AN/USM–306.	Level meter
Frequency Meter AN/USM–159.	Frequency meter
Voltmeter, Digital AN/GSM–64.	Digital voltmeter
Generator, Thermal Noise PRD–904.	Noise generator
Wave Analyzer, Bruel and Kjoer 2107.	Wave analyzer
Mixer SM-[illegible]-696046	
Adapter-Connector UG–636A/U.	
Dummy Load, Electrical DA–535/U.	
Adapter-Connector UG–107B/U.	
Cable Assembly, Special Purpose, Electrical CX–10762/GRC–103(V).	
Cable Assembly, Special Purpose, Electrical CMC 217–800009.	

b. Test Procedures.

(1) *Preliminary operational checks.*

(*a*) Connect the test equipment as shown in A, figure 4–379.

(*b*) Set the voltage control on the power supply (part of the accessory kit) to 115v ac.

(*c*) Set the unit under test AC POWER switch to ON. Observe the following:

1. The AC POWER lamp should light.

2. The LOW SIGNAL alarm lamp should light.

3. If the SYNC alarm lamp lights, it should go out again within 10 seconds.

4. The buzzer may sound; press the BUZZER OFF button to silence the buzzer.

(*d*) On the unit under test, set the meter selector switch to the following positions and observe the meter indications:

Switch position	Typical indication
+12V DC	Within the green band
−12V DC	Within the green band
OSC	20% to 90% of full scale
DOUBLER	20% to 90% of full scale
MULT	0 to 10% of full scale (off tune).
RCVR SIG	Less than 40% of full scale

(*e*) Set the unit under test controls as follows:

Control	Position
VR CHANNEL	Channel 1090
VR SIG	Channel 1090
MTR DUPL	At least 50 channels away from RCVR SIG channel.
eter selector switch	MULT

(*f*) Tune the MULT PEAK control for aximum indication on the meter. The VTVM ould indicate approximately —9 dbm.

(*g*) Set the meter selector switch to RCVR IG; the meter should indicate less than 40 per- nt of full scale.

(*h*) Set signal generator No. 2 to 745 MHz an output of —64 dbm (—74 at the ANT nnector of the unit under test). The LOW SIG- AL alarm lamp should go out and the buzzer ould sound. Silence the buzzer.

(*i*) Adjust the unit under test RCVR SIG ntrol for a maximum indication on the meter. Tune the RCVR SIG control for a ten percent op on either side of maximum, then set the CVR SIG control midway between these two ints.)

(*j*) Observe the VTVM indication; it should be approximately —46 dbm or less.

NOTE

The minimum VTVM indication and maximum RCVR SIG meter indication should occur simultaneously (at the same RCVR SIG setting).

(*k*) Set the AC POWER switch to OFF.

(*l*) Not used.

(*m*) Remove radio receiver 1RE1 from the receiver case and use extension cables CX–12056/U (1 ft 3 in.) and CX–12057/U (1 ft) to restore connections. Set the AC POWER switch to ON and check the meter indications.

Meter selector switch position	Typical indication
+12V DC	Within the green band
−12V DC	Within the green band
OSC	20% to 90% of full scale
DOUBLER	20% to 90% of full scale
MULT	20% to 90% of full scale
RCVR SIG	Above 40% of full scale

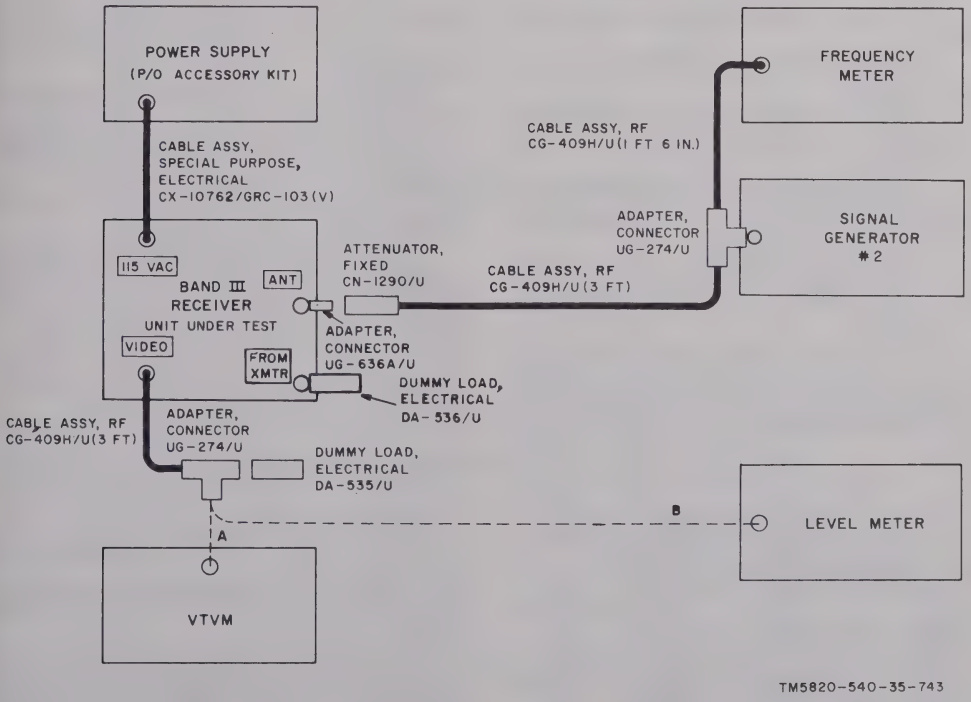


Figure 4–379. Receiver receive signal adjustment and spurious interference checks, test setup.

(2) *Received signal monitoring.*

NOTE

This adjustment is a continuation of the preliminary operational checks above.

(*a*) Adjust the signal generator output to —40 dbm (—50 dbm input at the ANT. connector of the unit under test).

(*b*) Locate the RCVR SIG ADJUSTMENT control (on the right-hand side of the extended radio receiver 1RE1) and set it fully clockwise.

(*c*) Locate the RCVR SIG METER control of the video amplifier 1RE1AR1 (figs. 3–32 and 4–106) and adjust it for a 60 percent of full scale indication on the meter (meter selector switch in the RCVR SIG position).

(*d*) Reduce the level of signal generator No. 2 to —115 dbm. RCVR SIG meter indication should be below 40 percent. The LOW SIGNAL alarm lamp should light and the buzzer should sound. Silence the buzzer.

(*e*) Increase the output level of signal generator No. 2 to —85 dbm. The RCVR SIG meter indication should increase by more than 10 percent. The LOW SIGNAL alarm should go out and the buzzer should sound. Silence the buzzer.

(*f*) If these conditions are not met proceed as follows:

1. Adjust signal generator No. 2 output level to —40 dbm.

2. Turn the RCVR SIG ADJUSTMENT counterclockwise until the meter indicates 50 percent of full scale.

3. Readjust the RCVR SIG METER control on video amplifier 1RE1AR1 for 60 percent of full scale indication on the meter.

4. Repeat the tests described in (*d*) and (*e*) above. If necessary, repeat the adjustment procedure above.

(*g*) Repeat the receive signal monitoring checks ((*a*) through (*e*) above) for the channels shown below. Tune for maximum RCVR SIG indications with signal generator No. 2 output level at —64 dbm.

Test channel	RCVR CHANNEL and RCVR SIG setting	XMTR DUPL setting	Signal generator frequency (MHz)
1000	1000	1600	700
1100	1100	1600	750
1200	1200	1600	800
1300	1300	1600	850
1400	1400	1000	900
1500	1500	1000	950
1600	1600	1000	1000

(3) *Demodulation sensitivity check.*

(*a*) Connect the test equipment as shown in A, figure 4–380.

(*b*) Set signal generator No. 2 frequency to 900 MHz as indicated on the frequency meter.

(*c*) Set the unit under test controls as follows:

Control	Position
RCVR CHANNEL	Channel 1400
RCVR SIG	Channel 1400
XMTR DUPL	At least 100 channels away from the RCVR SIG channel.
AC POWER	ON
MULT PEAK	Tune for maximum meter indication.

(*d*) Set the test facility switches as follows:

Switch	Position
S1	ON
S9	30 MHz LEVEL
S14	30 MHz
AT1	0 DB

(*e*) Adjust signal generator No. 2 output level to obtain a 5.0-mv indication on the VTVM.

(*f*) Set the facility switch S9 to 300 KHZ DEVIATION.

(*g*) Set the unit under test meter selector switch to 24 CH PCM; the meter should indicate within the green band. The VTVM should indicate 0.265v ± 0.03v rms (—9.4 dbm ± 1 db).

(*h*) Set test facility switch S9 to 180 KHZ DEVIATION.

(*i*) Set the unit under test meter selector switch to 12 CH PCM; the meter should indicate within the green band. The VTVM should indicate 0.159v ± 0.018v rms (—13.7 dbm ± 1 db).

(*j*) On the unit under test, remove the dummy load from the PCM output connector. The meter indication should drop to zero.

(*k*) On the unit under test replace the dummy load at the PCM output connector. The meter should indicate within the green band.

(*l*) Not used.

(*m*) Connect the test equipment as shown in B, figure 4–380.

(*n*) Set the test facility switch S9 to 75 KHZ DEVIATION.

(*o*) Set the unit under test meter selector switch to FDM; the meter should indicate within the green band. The VTVM should indicate 0.189v + 0.021v rms.

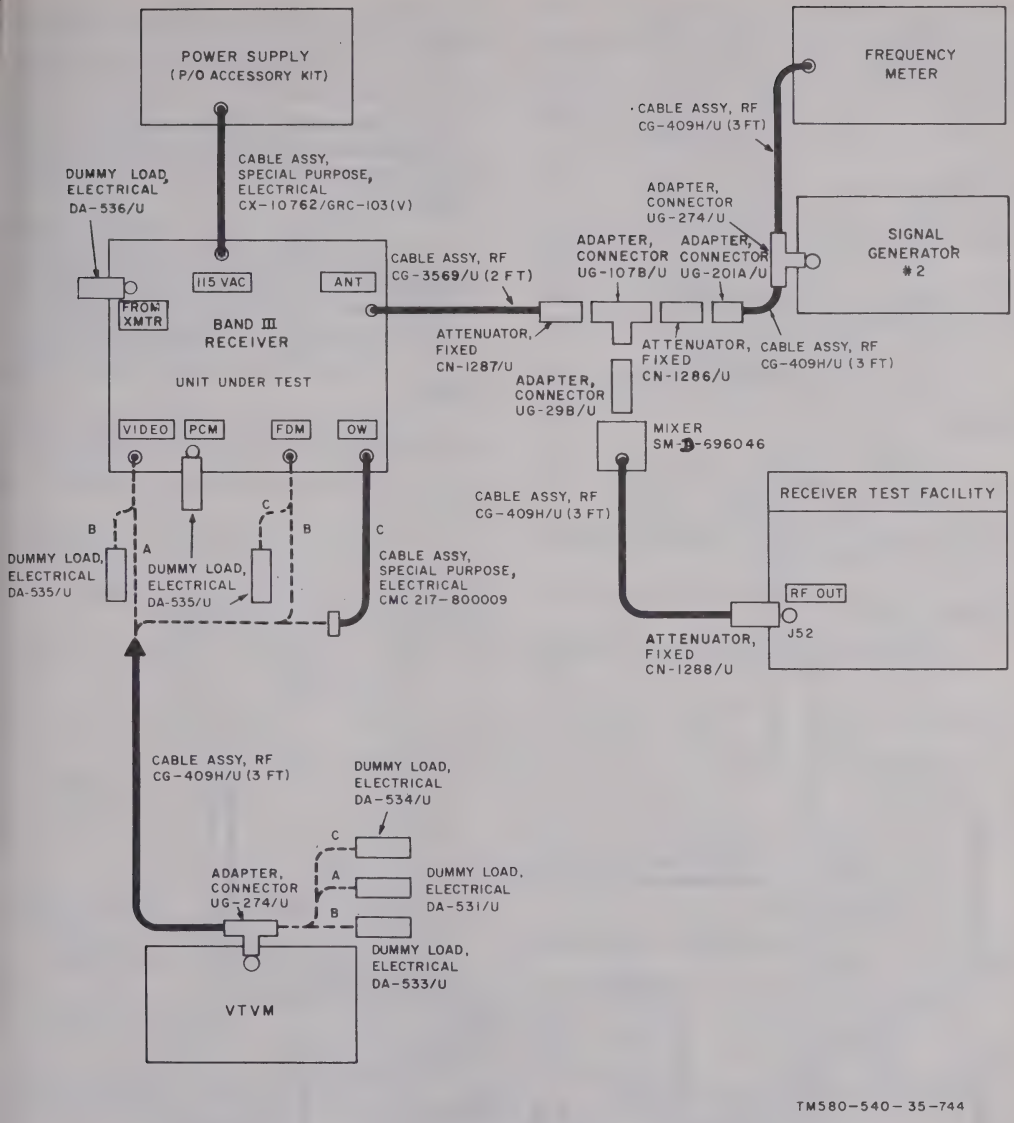


Figure 4-380. Band III receiver demodulation sensitivity check, test setup.

(*p*) Connect the test equipment as shown C, figure 4-380.

(*q*) Set the test facility switch S9 to 45 IZ DEVIATION.

(*r*) Set the unit under test meter selector itch to OW; the meter should indicate within e green band. The VTVM should indicate 0.245v 0.045v rms (—10 dbm ± 2 db).

(4) *Video gain stability measurement.*

(*a*) *Initial calibration procedure.*

1. Connect the test equipment as shown in B, figure 4-379.

2. Set signal generator No. 2 frequency to 760 MHz at a level of —85 dbm (—95 dbm signal at the ANT. connector).

3. Set the unit under test controls as follows:

Control	Position
RCVR CHANNEL	Channel 1120
RCVR SIG	Channel 1120
XMTR DUPL	At least 100 channels away from the RCVR SIG setting.
AC POWER	ON
MULT PEAK	Tune for maximum meter indication.

4. On the unit under test set the meter selector switch to RCVR SIG and adjust the frequency of signal generator No. 2 for a maximum indication on the unit under test meter.

5. Set the level meter frequency to 400 kHz at 2.0 kHz bandwidth. Record the level meter indication.

6. Repeat *1* through *5* above for signal generator No. 2 output levels of —74 dbm, —54 dbm, and —44 dbm. (—84 dbm, —64 dbm, and —54 dbm inputs at the ANT. connector.) Record each level meter indication.

7. Connect the test equipment as shown in A, figure 4–381.

8. Set signal generator No. 2 frequency to 730 MHz ± 30 kHz as shown on the frequency meter.

9. Set test facility switches S1 to ON and S9 to 30 MHZ LEVEL.

10. Adjust signal generator No. 2 output level to obtain an identical level meter indication as in *5* above. Record signal generator No. 2 attenuator setting.

11. Repeat *10* above to obtain identical level meter indications as in *6* above for each signal generator No. 2 level used. Record each of the signal generator No. 2 attenuator settings.

(*b*) *Video gain stability vs output level.*

1. Use the test setup shown in B, figure 4–381.

2. Return the signal generator attenuator setting to that recorded in (*a*)*10* above.

3. Set the test facility switches as follows:

Switch	Position
S9	EXT. VIDEO
S14	30 MHz
AT1	0 DB

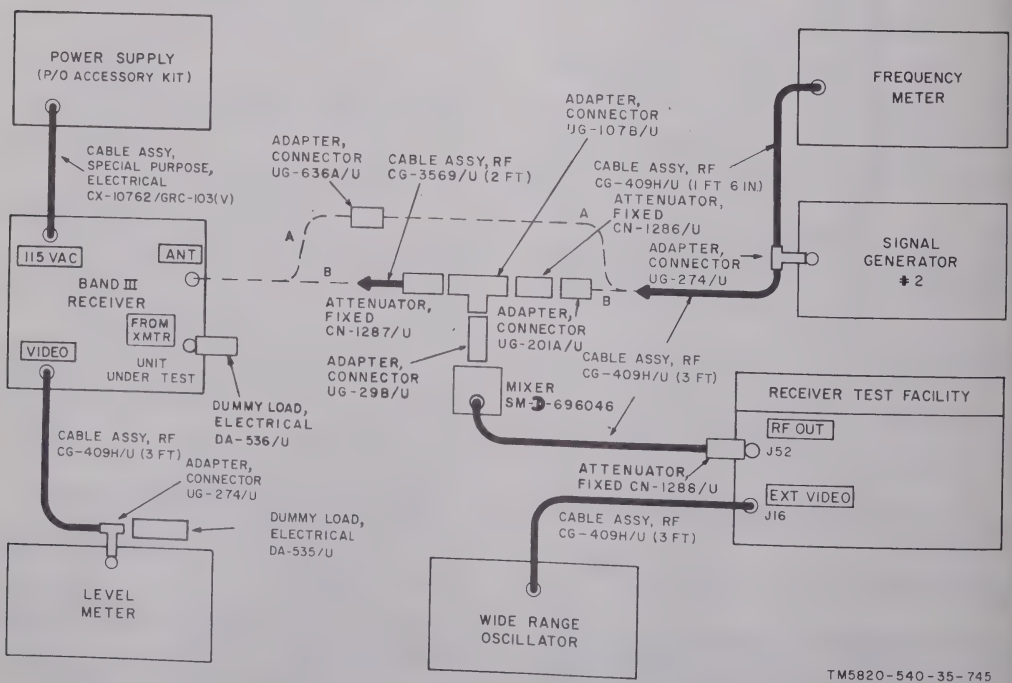


Figure 4–381. Band III receiver video gain stability check, test setup.

4. Set the level meter to 10 kHz.

5. Set the wide range oscillator to 10 kHz and adjust the output level for a —5 dbm indication on the level meter.

6. Return signal generator No. 2 attenuator to each of the settings recorded in (*a*)*11* above. The level meter indication should remain within —5 dbm ± 0.5 db for each of the above attenuator settings.

7. Return signal generator No. 2 attenuator to the setting recorded in (*a*)*10* above. The level meter indication should return to —5 dbm.

(*c*) *Video gain stability vs supply voltage variation.*

1. With the equipment set as in (*b*)*7* above, vary the voltage control on the power supply (part of the accessory kit) between 105 volts and 125 volts ac. The level meter indication should remain within —5 dbm ± 0.5 db.

2. Set the voltage control on the power supply to 115 volts ac.

3. Disconnect the power supply from the 60-Hz source and connect it to a 400-Hz source. The level meter indication should remain within —5 dbm ± 0.5 db.

4. Reconnect the power supply to the 60-Hz source.

(5) *Video frequency response.*

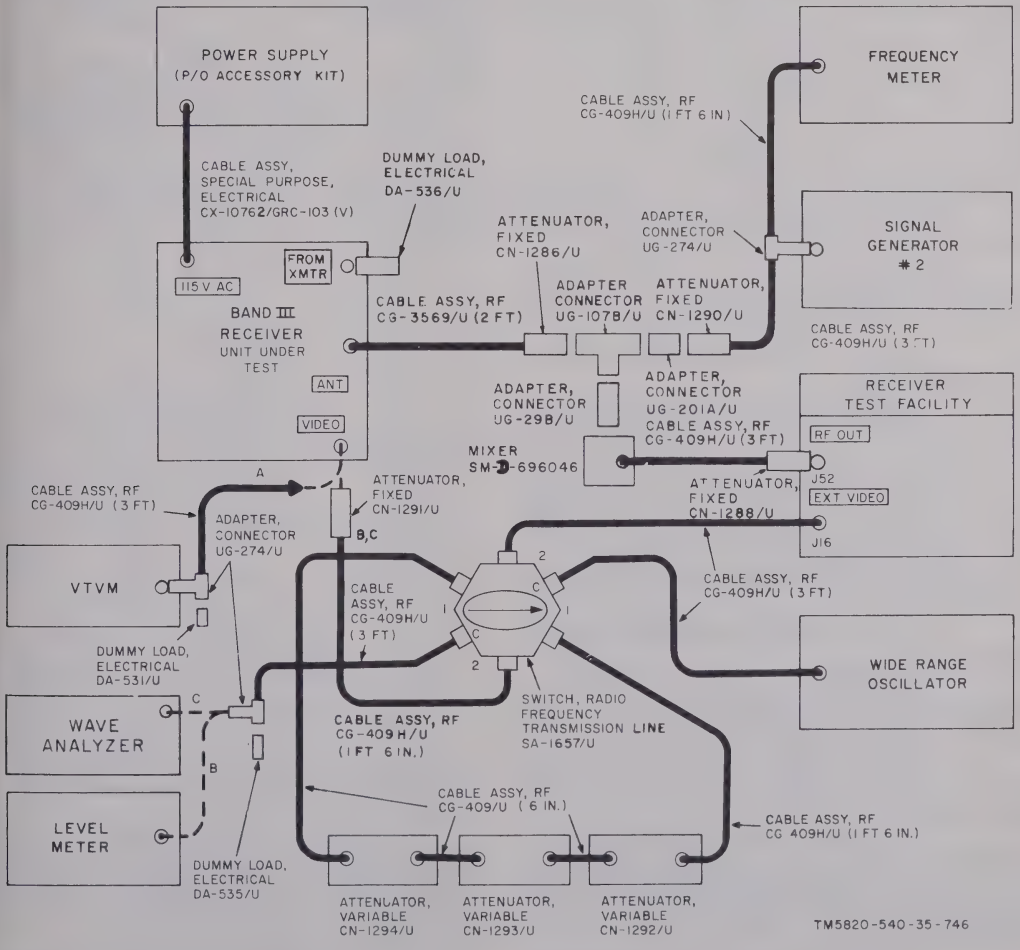


Figure 4–382. Band III receiver video frequency response check, test setup.

(*a*) *Initial calibration procedure.*

1. Connect the test equipment as shown in A, figure 4-382.

2. Set the unit under test controls as follows:

Control	Position
RCVR CHANNEL	Channel 990
RCVR SIG	Channel 990
XMTR DUPL	At least 60 channels away from RCVR SIG channel.
AC POWER	ON

3. Set signal generator No. 2 frequency to 665 MHz ± 30 kHz as shown on the frequency meter.

4. Set the test facility switches as follows:

Switch	Position
S1	ON
S9	30 MHz LEVEL
S14	30 MHz
AT1	0 DB

5. Adjust signal generator No. 2 attenuator for a 6 mv indication on the VTVM.

6. Set the unit under test meter selector switch to RCVR SIG and tune the RCVR SIG control for a maximum meter indication.

7. Connect the test equipment as shown in B, figure 4-382.

8. Set the coaxial switch to position 2.

9. Set test facility switch S9 to 75 KHZ DEVIATION.

10. Set the unit under test meter selector switch to FDM; the meter should indicate within the green band. Note the meter indication.

11. Set test facility switch S9 to EXT VIDEO.

12. Check the signal-to-noise ratio as described below.

(a) Set the wide range oscillator to 400 kHz and adjust the output level until the unit under test meter indicates as in *10* above.

(b) Set the level meter to 400 kHz with 2.0 kHz bandwidth and record the level meter indication.

(c) Disconnect the wide range oscillator from the coaxial switch and record the level meter indication. The difference between this reading and the one recorded in (b) above should be greater than 20 db.

(d) Reconnect the wide range oscillator to the coaxial switch.

(*b*) *Frequency response measurement.*

1. With the coaxial switch in position 2 set the wide range oscillator to 10 kHz and adjust the output level until the unit under test meter indicates as in (*a*)*10* above.

2. Set the level meter to 10 kHz and the bandwidth to 2.0 kHz. Record the level meter indication.

3. Set the coaxial switch to position 1. Adjust the variable attenuators for the same level meter indication as in *2* above ± 0.1 db. Record the variable attenuator settings; this is the reference level.

4. Repeat *1* through *3* above for all frequencies listed in the chart below and record the attenuation with respect to the reference level obtained in *3* above.

NOTE

For frequencies below 10 kHz, replace the level meter with the wave analyzer (C, fig. 4-382).

Wide range oscillator and level meter frequency (kHz)	Relative attenuation (db), reference 10 kHz		
	Nominal	Minimum	Maximum
0.125	1.0	0	2.5
0.200	0.5	0.2	1.0
0.250	0.2	−0.2	0.4
1	0	−0.1	0.1
10	Reference		
30	0	−0.1	0.1
60	0.15	0.05	0.25
120	0.6	0.2	0.9
180	1.3	0.8	1.8
240	2.3	1.8	2.8
360	5.1	4.4	5.8
480	9.0	8.2	10.0
600	14.0	12.5	15.5
720	20.2	18.4	22.6
840	27.5	25.3	31.0
960	36.0	33.0	40.0

NOTE

Check that the attenuation at 360 kHz does not change by more than ± 1 db when the XMTR DUPL control is tuned across its range, except within ± 32 channels of the RCVR CHANNEL setting.

5. Set the RCVR CHANNEL and RCVR SIG controls to 1600 and XMTR DUPL control to 1500. Set signal generator frequency to 970 MHz and repeat steps *1* through *4* above.

(6) *Noise figure measurement.*

(*a*) Connect the test equipment as shown in A, figure 4-383.

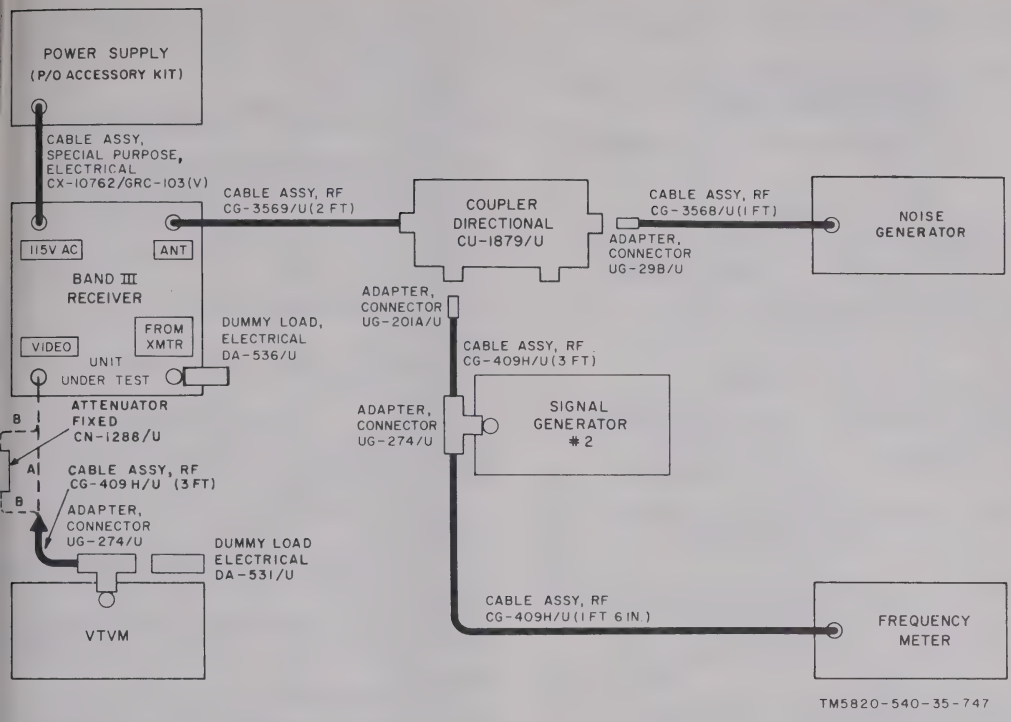


Figure 4-383. Band III receiver noise figure measurement, test setup.

(*b*) Set noise generator switch 10-20 to 10 d its output level control to OFF.

(*c*) Set signal generator No. 2 frequency to MHz and its output level to —54 dbm (—74 m at the ANT. connector).

(*d*) Set the unit under test controls as fol-s:

Control	Position
VR CHANNEL	Channel 1000
VR SIG	Channel 1000
TR DUPL	At least 100 channels away from RCVR SIG setting.
POWER	ON
er selector switch	MULT

(*e*) Tune the MULT PEAK control for ximum meter indication. Set the meter selector tch to RCVR SIG and tune the RCVR SIG trol for a maximum meter reading. The noise el as indicated on the VTVM should be approx-ately —46 dbm. Note the VTVM indication.

(*f*) Insert a 3 db attenuator between the DEO connector and the VTVM (B, fig. 4-383).

(*g*) Adjust the output level control on the noise generator to obtain the same VTVM indication as in (*e*) above. Allow 10 seconds for conditions to stabilize. Read the noise figure on the noise generator meter; it should not exceed 8 db. Return the output level control to OFF after each reading.

(*h*) Repeat (*c*) through (*g*) above for all test channels listed in the chart below keeping the XMTR DUPL setting at least 100 channels away from the RCVR SIG setting.

RCVR SIG and RCVR CHANNEL setting	Signal generator No. 2 frequency (MHz)
1000	700
1200	800
1400	900
1600	1000

(7) *Power consumption check.*

(*a*) Connect the equipment to the power supply (part of the accessory kit).

(*b*) Set the voltage control on the power supply to 115v ac.

(*c*) Set the unit under test AC POWER

switch to ON and note the indication on the power supply ammeter; it should be 0.45 ampere.

4-192. Radio Set AN/GRC-103(V)3 System Tests and Alignment

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/GRM-95(V).	Transmitter test facility
Test Facility, Receiver TS-2867(V)1/GRM-95(V).	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V).	Accessory kit
Voltmeter, Electronic ME-30A/U.	VTVM
Generator, Signal AN/USM-205.	Wide range oscillator
Generator, Signal SG-409( )/U.	Signal generator No. 1
Generator, Signal SG-340A/G	Signal generator No. 2
Selective Voltmeter AN/USM-306.	Level meter
Wattmeter AN/URM-120	Wattmeter
Frequency Meter AN/USM-159.	Frequency meter
Mixer SM-D-696046	
Cable Assembly, Special Purpose, Electrical, Branched CMC 217-800012.	
Cable Assembly, Special Purpose, Electrical, Branched CMC 217-800011.	
Distortion Analyzer TS-1344/U.	Distortion analyzer
Oscilloscope AN/USM-281	Oscilloscope
Wave Analyzer Bruel and Kjoer 2107.	Wave analyzer
Adapter-Connector UG-636 A/U.	
Cable Assembly, Special Purpose, Electrical, Branched CX-10763/GRC-103(V).	
Cable Assembly, Special Purpose, Electrical, CX-10762/GRC-103(V) (2 required).	
Cable Assembly, RF CG-3444/U (1 ft 6 in.).	

b. Test Procedures.

(1) *Transmitter antenna power check.*

(*a*) Connect the test equipment as shown in figure 4-384.

(*b*) Set the receiver and transmitter AC POWER switches to their ON and ON/RESET position.

(*c*) Set the voltage control on the accessory kit power supply to 115v ac ± 2v as indicated on

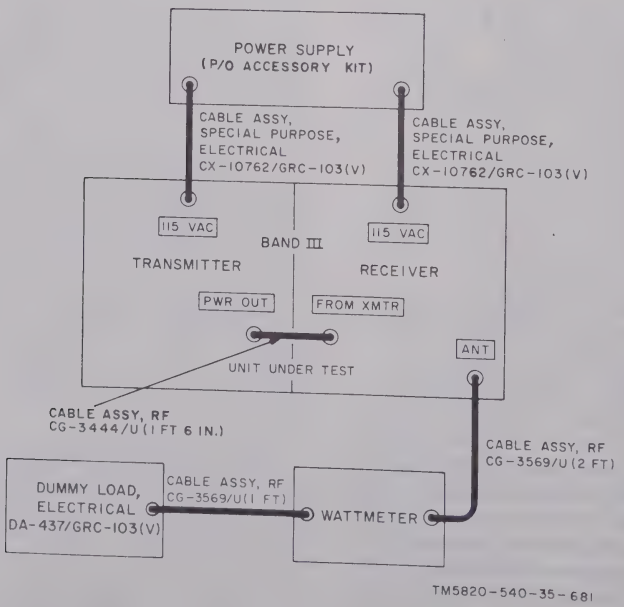


Figure 4-384. Band III radio set output power to antenna, test setup.

VOLTS meter. Keep the voltage within the ove limits during the tests. The ammeter on the wer supply should indicate less than 4.1 am- res.

(*d*) Observe the following on the unit der test:

1. AC POWER lamps should light.

2. SYNC alarm lamps may light; they ould extinguish within 10 seconds.

3. LOW POWER alarm lamp should ht.

4. LOW SIGNAL alarm lamp should ht.

5. Buzzers should sound; silence the zzers.

6. Blower should operate.

(*e*) On the receiver, set the RCVR CHAN- EL and RCVR SIG controls to channel 1600 and MTR DUPL control to channel 1000.

(*f*) On the transmitter, set the XMTR HANNEL and XMTR TUNE controls to chan- l 1000. Set the meter selector switch to the fol- wing positions in turn and observe the meter dication:

Meter selector switch position	Typical meter indication
V DC	within green band
V DC	within green band
0V DC	within green band
C	20% to 90% full scale
OUBLER	20% to 90% full scale
ULT	20% to 90% full scale
RIVER	20% to 90% full scale*

* May be less than 20% until unit is fully tuned.

(*g*) Set the transmitter meter selector vitch to PWR OUT and adjust the XMTR UNE control for maximum indication on the ansmitter meter. The meter should indicate not ss than 40 percent of full scale. The LOW OWER alarm light should go out and the buzzer ould sound; silence the buzzer.

(*h*) Set the transmitter meter selector vitch to REFL PWR and tune the receiver MTR DUPL control for minimum indication on e transmitter meter; the meter should indicate ss than 15 percent of full scale.

(*i*) Set the receiver meter selector switch XMTR DUPL. Readjust the XMTR DUPL con- ol on the receiver for maximum indication on e receiver meter, keeping the XMTR CHAN- EL indication within 0.5 inch of the center of e display window. The receiver meter should dicate not less than 40 percent of full scale.

(*j*) Set the receiver meter selector switch to REFL PWR; the receiver meter should indicate less than 15 percent of full scale and the wattmeter should indicate not less than 13 watts.

(*k*) Repeat steps (*e*) through (*j*) above for the channels listed below.

(*l*) Not used.

NOTES

1. Omit the 12V DC, 28V DC, and 600V DC meter checks in (*f*) above.
2. Set the AC POWER switch on the transmitter to OFF when changing receiver channel from 1600 to 1000.

XMTR CHANNEL XMTR DUPL and XMTR TUNE channel settings	RCVR CHANNEL and RCVR SIG channel settings
1000	1600
1100	1600
1200	1600
1300	1600
1400	1000
1500	1000
1600	1000

(*m*) Set the AC POWER switch on transmitter to OFF.

(2) *System gain and frequency response measurement.*

(*a*) *Initial calibration.*

1. Connect the test equipment as shown in A, figure 4–385.

2. Set the signal generator No. 2 frequency to 820 MHz as indicated on the frequency meter and set the output level to —94 dbm.

3. Set the coaxial switch to position 1.

4. Set the receiver controls as follows:

Control	Setting
RCVR CHANNEL	Channe. 1240
RCVR SIG	Channel 1240
XMTR DUPL	Channel 1340
AC POWER	ON
Meter selector switch	MULT
MULT PEAK	Tune for maximum meter indication.
Meter selector switch	RCVR SIG
RCVR SIG	Tune for maximum meter indication.

5. Set the level meter to 400 kHz and 2.0 kHz bandwidth. Record the level meter indication.

6. Record the level meter indications for signal generator output levels of —84 dbm, —74 dbm, —64 dbm and —54 dbm. The level meter

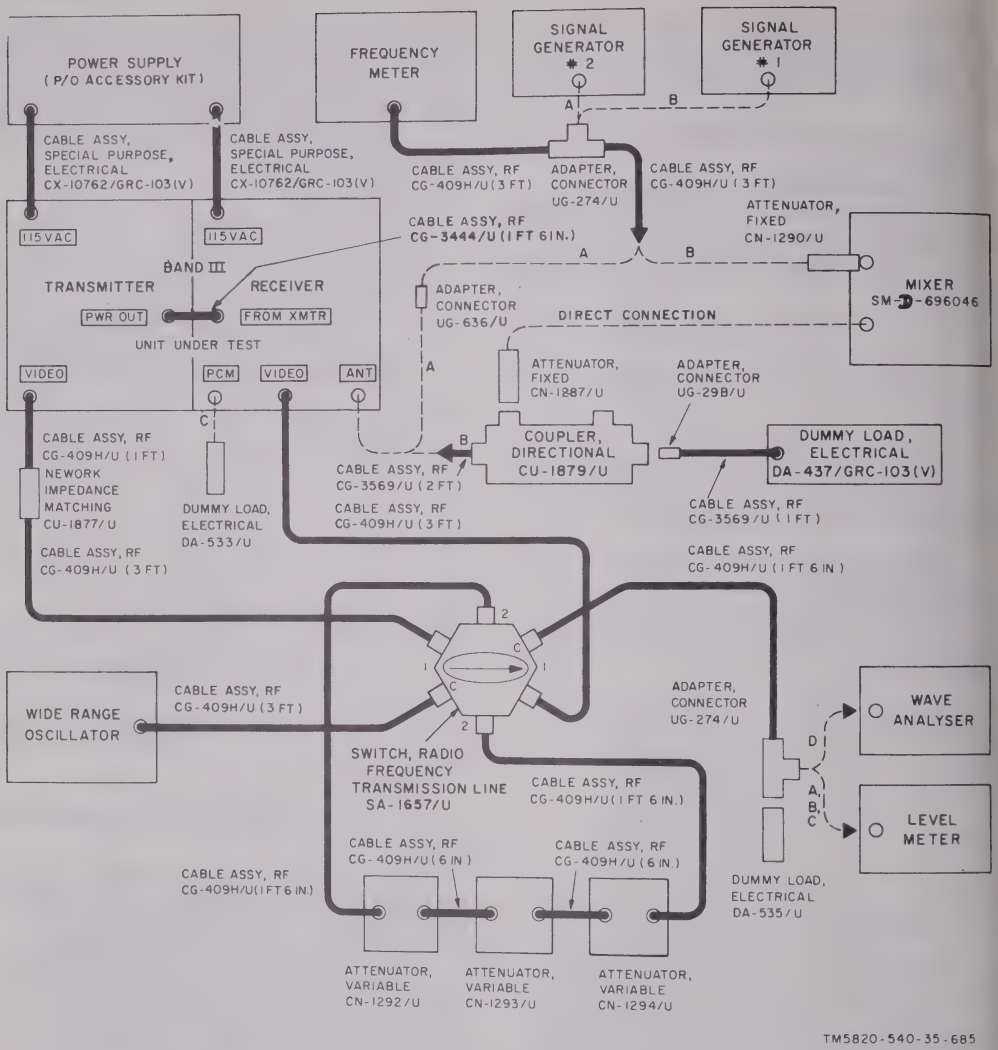


Figure 4–385. Band III radio set, system gain and frequency response measurement, test setup.

indications should decrease in approximately 10 db steps.

NOTE

Agc action may be noticed before reaching the —54 dbm level.

7. Connect the test equipment as shown in B, figure 4–385 with coaxial switch in position 1.

8. Disconnect the wide range oscillator.

9. Set the AC POWER switch on th transmitter to on/RESET.

10. Set the transmitter to channel 134 and tune for maximum PWR OUT as described i (1) (*f*) through (*j*) above.

11. Set signal generator No. 1 frequenc to 50 MHz and adjust the output level until th level meter indication is the same as obtained in above for —74 dbm.

NOTE

Use this signal generator output level

throughout the following system gain and frequency response measurement ((*b*) and (*c*) below).

12. Reconnect the wide range oscillator.

(*b*) *System gain measurement.*

1. With the test equipment connected as own in B, figure 4–385, set the coaxial switch to ition 1.

2. Set the transmitter and receiver meter ector switch to 24 CH PCM.

3. Set the transmitter INPUT control to drange.

4. Set the wide range oscillator to 10 z and adjust the output level for a 50 percent ication on the transmitter meter. The receiver ter should indicate between 40 and 65 percent full scale.

5. Set the level meter to 10 kHz and 2.0 z bandwidth. The level meter should indicate .3 dbm ± 3 db.

6. Set transmitter and receiver meter ector switch to 12 CH PCM.

7. Terminate the PCM connector on the t under test with a 91-ohm load (C, fig. 4–385).

8. Repeat steps *3* through *5* above. The el meter should indicate —4.8 dbm ± 3 db and receiver meter should indicate within the en band.

(*c*) *Frequency response measurement.*

1. Connect the test equipment as shown in B, figure 4–385.

2. Set the coaxial switch to position 1.

3. Set the transmitter and receiver meter selector switch to FDM. Set the INPUT control to midrange.

4. Set the wide range oscillator to 10 kHz and adjust the output level control for a 65 percent full scale indication on the transmitter meter.

5. Set the wide range oscillator to 960 kHz and the level meter to 960 kHz and 2.0 kHz bandwidth. Record the level meter indication.

6. Temporarily disconnect the wide range oscillator and note the level meter indication. It should be at least 20 db below the level recorded in *5* above. Reconnect the wide range oscillator.

7. Set the wide range oscillator to 10 kHz. Record the output level of the wide range oscillator as indicated on its own meter. Maintain this level throughout the remaining steps.

8. Set the level meter to 10-kHz and 2.0-kHz bandwidth. Record the level meter indication.

9. Set the coaxial switch to position 2. Adjust the variable attenuators to obtain the same level meter indication as in *8* above. Record

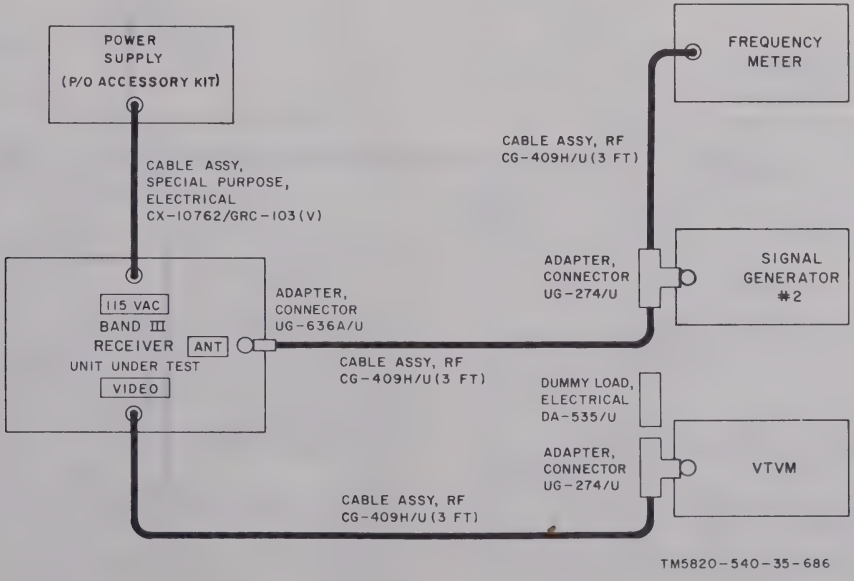


Figure 4–386. Band III receiver deviation calibration procedures, test setup.

the variable attenuators setting; this is the 10-kHz reference level.

10. Repeat steps *8* and *9* above with the wide range oscillator set to all modulating frequencies above 10 kHz listed in the chart below.

Modulating frequency (kHz)	Relative attenuation (db), reference attenuation 10 kHz		
	Nominal	Minimum	Maximum
0.125	2.0	1.0	3
0.200	1.0	0	2
0.250	0.4	0	0.8
0.5	0	−0.1	0.1
1.0	0	−0.1	0.1
10	REF	REF	REF
30	0	−0.1	0.2
60	0.2	0.1	0.4
120	0.7	0.5	1.0
180	1.6	1.3	2.2
240	2.9	2.5	4.0
360	6.5	5.7	8.0
480	11.7	10.2	13.5
600	18.2	16.0	21.0
720	26.2	23.1	30.5
840	35.7	31.7	41.0
960	46.7	41.2	52.5

The relative attenuation should be within the co responding limits shown.

11. Replace the level meter with th wave analyzer as shown in D, figure 4–385.

12. Set the wave analyzer switches a follows:

Control	Position
INPUT	DIRECT
METER	RMS, FAST
METER RANGE	as required
RANGE MULTIPLIER	−20 DB
FUNCTION SELECTOR	FREQUENCY ANALYSIS
WEIGHTING NETWORK	LINEAR 2 to 4000

13. Repeat steps *8* and *9* above for a modulating frequencies below 10 kHz listed table above. The relative attenuation should within the corresponding limits shown.

(3) *Signal-to-noise and high signal prote tion circuits check.*

(*a*) *Deviation calibration procedure.*

1. Connect the test equipment as figure 4–386.

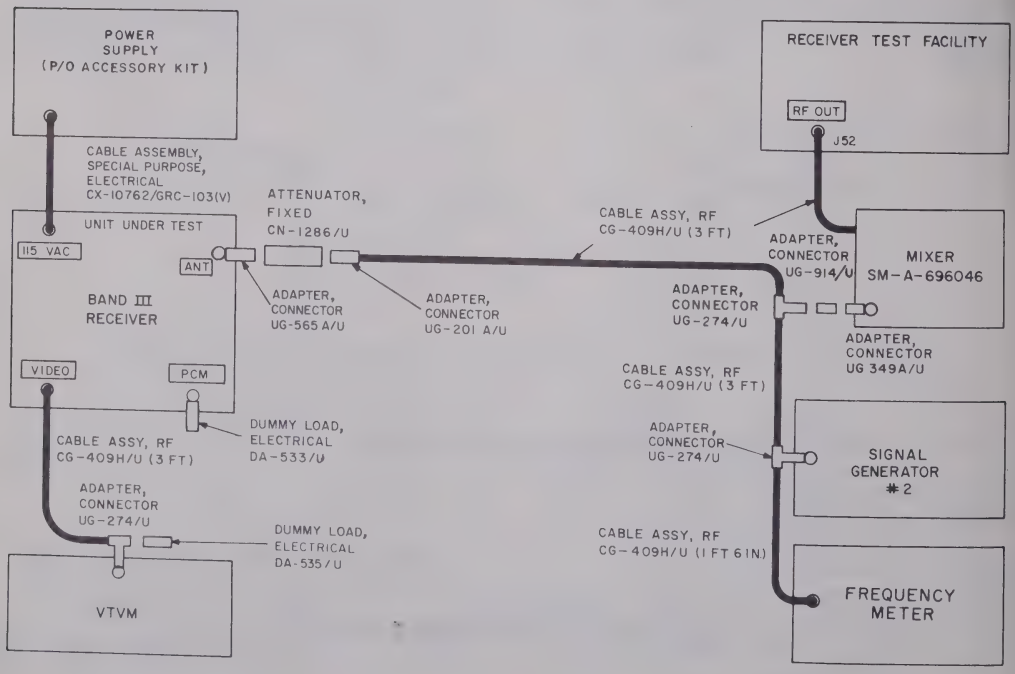


Figure 4–387. Band III radio set deviation measurement, test setup.

2. Set signal generator No. 2 frequency 320 MHz as indicated on the counter and set output level to —74 dbm.

3. Set the receiver controls as follows:

Control	Setting
VR CHANNEL	Channel 1240
VR SIG	Channel 1240
ITR DUPL	Channel 1340
POWER	ON
ter selector switch	MULT
JLT PEAK	Tune for maximum meter indication.
ter selector switch	RCVR SIG
VR SIG	Tune for maximum meter indication.

4. Record the noise level as indicated on e VTVM.

5. Set the signal generator output level —94 dbm and record the VTVM indication oise level).

6. Connect the test equipment as shown figure 4-387.

7. Set signal generator No. 2 to 850 MHz indicated on the frequency meter.

8. Set the test facility switches as fol-ws:

Switch	Position
	ON
	30 MHZ LEVEL
	30 MHZ
	0 DB

NOTE

Check for maximum RCVR SIG meter indication on the receiver meter.

9. Adjust the signal generator output el to obtain the same VTVM indication (noise el) as in 4 above.

10. Set the test facility switch S9 to 180 HZ DEVIATION.

11. Set the receiver meter selector switch 12 CH PCM. The receiver meter should indi-te within the green band. The VTVM should dicate 159 mv ± 18 mv (—13.5 dbm ± 1 db); cord this indication.

12. Set the test facility switch S9 to 300 HZ DEVIATION.

13. Set the receiver meter selector switch 24 CH PCM. The receiver meter should indi-te within the green band; record this indication. The VTVM should indicate 265 mv ± 30 mv; record this indication.

14. Adjust the signal generator output for a VTVM indication (noise level) as obtained in 5 above and repeat steps 10 through 13 above. The VTVM should indicate as in 11 and 13 above.

(b) Signal-to-noise measurement.

1. Connect the test equipment as shown in figure 4-388.

2. Set signal generator No. 1 frequency to 50 MHz as indicated on the frequency meter.

3. Set the receiver controls as follows:

Control	Setting
RCVR CHANNEL	Channel 1240
RCVR SIG	Channel 1240
XMTR DUPL	Channel 1340
AC POWER	ON
Meter selector switch	MULT
MULT PEAK	Tune for maximum meter indication.
Meter selector switch	RCVR SIG
RCVR SIG	Tune for maximum meter indication.

4. Disconnect the wide range oscillator.

5. Switch on the transmitter set to channel 1340 and tune for maximum PWR OUT and minimum REFL PWR indications as described in (1)(g) through (i) above.

6. Adjust the signal generator output level for a VTVM noise level indication as obtained in (a)4 above.

7. Set the receiver and transmitter meter selector switch to 12 CH PCM. Set the transmitter INPUT control to midrange.

8. Reconnect the wide range oscillator.

9. Set the wide range oscillator to 10 kHz and adjust its output to obtain a 50 percent indication on the transmitter meter. The receiver meter should indicate as in (3)(a)11 above. The VTVM should indicate 159 mv ± 18 mv (—13.5 dbm ± 1 db); note this indication.

10. Disconnect the wide range oscillator and record the noise level on the VTVM. It should be at least 29.0 db below the level noted in 9 above.

11. Adjust the signal generator output level to obtain the same VTVM noise level as in (a)5 above.

12. Reconnect the wide range oscillator. The receiver meter should indicate as in (a)13 above. The VTVM should indicate 159 mv ± 18 mv (—13.5 dbm ± 1 db); note this indication.

13. Disconnect the wide range oscillator

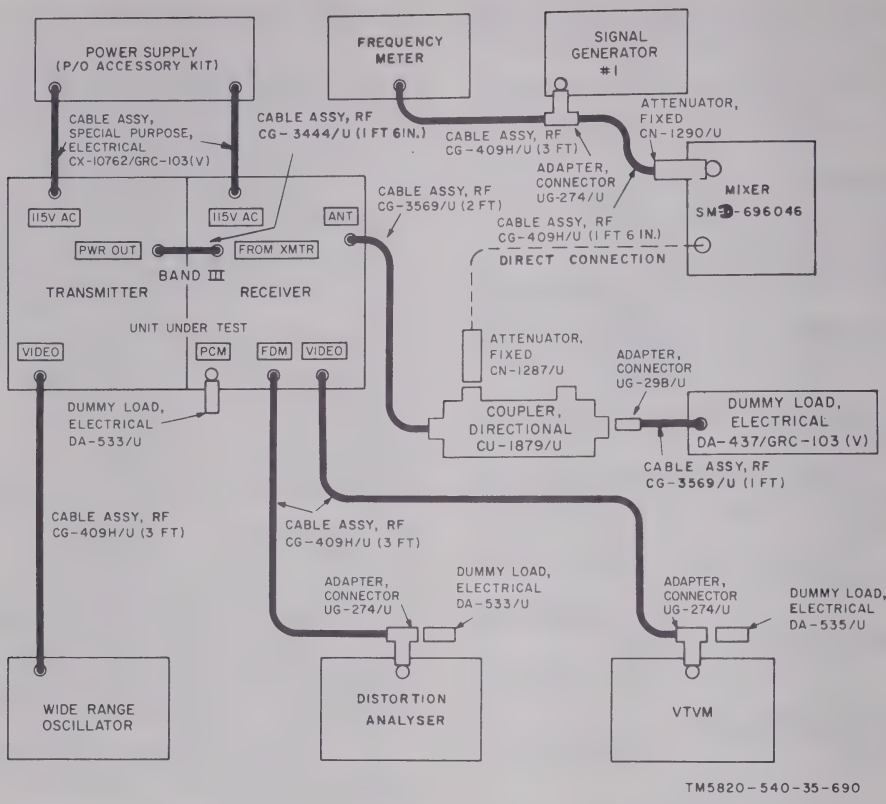


Figure 4-388. Band III radio set, signal-to-noise and harmonic distortion measurement, test setup.

and record the noise level as indicated on the VTVM; it should be at least 11.25 db lower than the level noted in *12* above.

14. Set the transmitter and receiver meter selector switch to 24 CH PCM.

NOTE

The equipment is set up for a —94 dbm signal level from the previous test.

15. Reconnect the wide range oscillator and adjust the output level to obtain a 50 percent indication on the transmitter meter. The VTVM should indicate 265 mv ± 30 mv; note this indication.

16. Disconnect the wide range oscillator and record the noise level on the VTVM. It should be at least 15.25 db below the level noted in *15* above.

17. Adjust the signal generator to obtain the same VTVM indication as recorded in (*a*) above.

18. Reconnect the wide range oscillat and adjust its output level to obtain a 50 perce full scale indication on the transmitter meter. T VTVM should indicate 265 mv ± 30 mv; note th indication.

19. Disconnect the wide range oscillat and record the noise level on the VTVM. It shou be at least 35.25 db below the level recorded in above.

(*c*) *High signal alarm and receiver prote tion check.*

NOTE

This is a continuation of the test in (*b*) above.

1. Tune the receiver RCVR SIG contr to channel 1340. The HIGH SIGNAL alarm lam

should light and the buzzer should sound; silence the buzzer.

2. Leave the equipment in this condition for approximately 30 seconds.

3. Reset the receiver to channel 1240. The HIGH SIGNAL alarm lamp should extinguish and the buzzer should sound; silence the buzzer.

4. Repeat the signal-to-noise tests in (*b*) above. There should be no degradation in the signal-to-noise ratio results.

(4) *Total harmonic distortion.*

(*a*) Set the AC POWER switch on the transmitter to OFF and connect the test equipment as shown in figure 4–386.

(*b*) Set signal generator No. 2 frequency to 820 MHz as indicated on the frequency meter and set the output level to —54 dbm.

(*c*) Set the receiver controls as follows:

Control	Setting
RCVR CHANNEL	Channel 1240
RCVR SIG	Channel 1240
XMTR DUPL	Channel 1340
AC POWER	ON
Meter selector switch	MULT
MULT PEAK	Tune for maximum meter indication.
Meter selector switch	RCVR SIG
RCVR SIG	Tune for maximum meter indication.

(*d*) Record the noise level as indicated on the VTVM.

(*e*) Connect the test equipment as shown in figure 4–388.

(*f*) Disconnect the wide range oscillator.

(*g*) Set the AC POWER switch on the transmitter to ON/RESET. Set the transmitter to channel 1340 and tune for maximum PWR OUT as described in (1)(*g*) through (*i*) above.

(*h*) Set the transmitter and receiver meter selector switch to 24 CH PCM and the transmitter INPUT control to midrange.

(*i*) Set signal generator No. 1 to 50 MHz as indicated on the frequency meter and adjust its output level for a VTVM noise level indication as obtained in (*d*) above.

(*j*) Reconnect the wide range oscillator; set the frequency of the wide range oscillator to 10 kHz and adjust its output level for a 50 percent indication on the transmitter meter. Record the wide range oscillator output level as indicated on its own meter. Receiver meter should indicate in the green band. The VTVM should indicate 265 mv ± 30 mv.

NOTE

Maintain above wide range oscillator output level throughout the following tests.

(*k*) Record the level indicated on the distortion analyzer in the SET LEVEL position.

(*l*) Not used.

(*m*) Set the distortion analyzer to DISTORTION and check the total harmonic distortion. It should be at least 26 db below the level obtained in the SET LEVEL position ((*k*) above).

(*n*) Repeat steps (*j*) through (*m*) above at wide range oscillator frequencies of 250 Hz and kHz.

(5) *Pcm performance test.*

(*a*) Set the AC POWER switch on the transmitter to OFF and connect the test equipment as shown in figure 4–386.

(*b*) Set signal generator No. 2 frequency to 820 MHz as indicated on the frequency meter and set the output level to —90 dbm.

(*c*) Set the receiver controls as follows:

Control	Setting
RCVR CHANNEL	Channel 1240
RCVR SIG	Channel 1240
XMTR DUPL	Channel 1340
AC POWER	ON
Meter selector switch	MULT
MULT PEAK	Tune for maximum meter indication.
Meter selector switch	RCVR SIG
RCVR SIG	Tune for maximum meter indication.

(*d*) Record the noise level as indicated on the VTVM.

(*e*) Connect the test equipment as shown in figure 4–389 with signal generator No. 1 connected in the test setup.

(*f*) Set the transmitter to channel 1340 and tune for maximum PWR OUT as described in (1)(*g*) through (*i*) above.

(*g*) Disconnect the receiver test facility cable from the VIDEO connector of the transmitter.

(*h*) Set signal generator No. 1 frequency to 50 MHz as indicated on the frequency meter and adjust the output level to obtain the same VTVM noise level indication as in (*d*) above.

(*i*) Set the test facility switches S1 to ON and S15 to PCM & TMG.

(*j*) Set the oscilloscope controls as follows:

TRIGGER	EXT
TIME/CM	.5 μsec
SWEEP MODE	NORMAL
VOLTS/CM (A & B)	.5

(*k*) Set the transmitter and receiver meter selector switch to 12 CH PCM.

(*l*) Not used.

(*m*) Reconnect the receiver test facility to the transmitter VIDEO connector.

(*n*) Adjust the transmitter INPUT control for a 50 percent indication on the transmitter meter. The receiver meter should indicate within the green band.

(*o*) Observe the regenerated pcm signal and the timing pulse as displayed on channels A and B of the oscilloscope (fig. 4–390). Check the following pulse characteristics:

1. The regenerated pulse amplitude (A, fig. 4–390) should be 2.0v ± 0.2v.

2. The timing pulse amplitude (B, fig. 4–390) should be 2.0v ± 0.2v.

(*p*) Set both oscilloscope amplifiers to 0.2 v/cm dc. Check the following pulse characteristics:

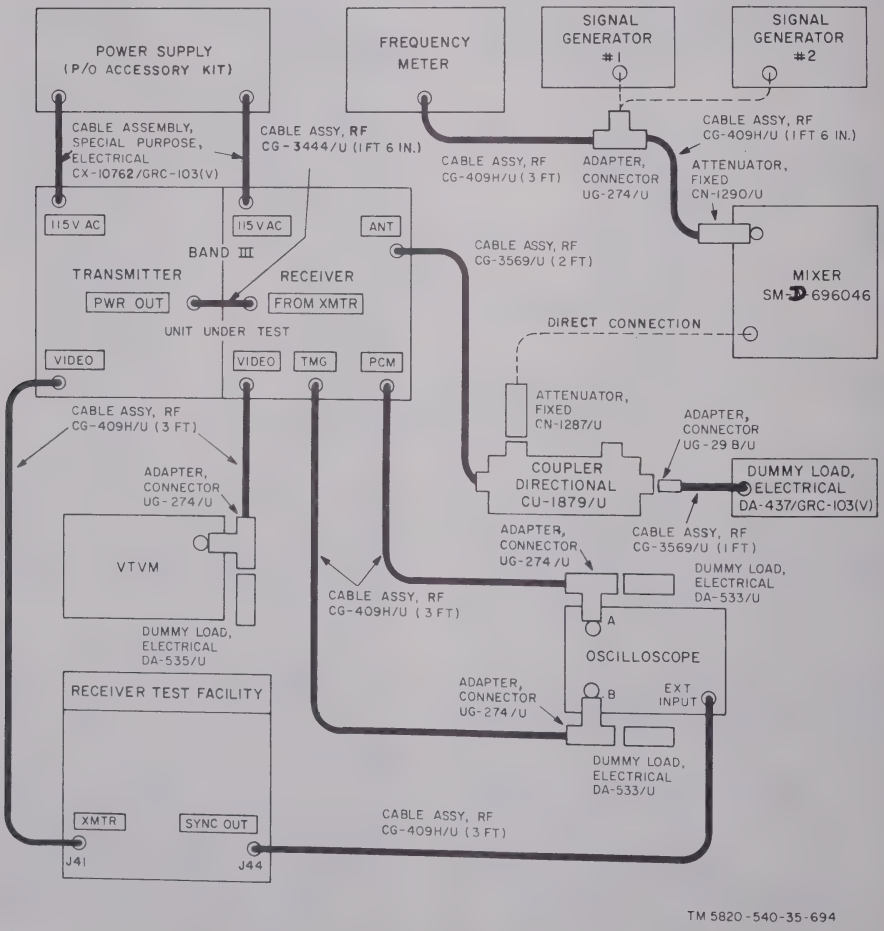


Figure 4–389. Band III radio set, pcm performance, test setup.

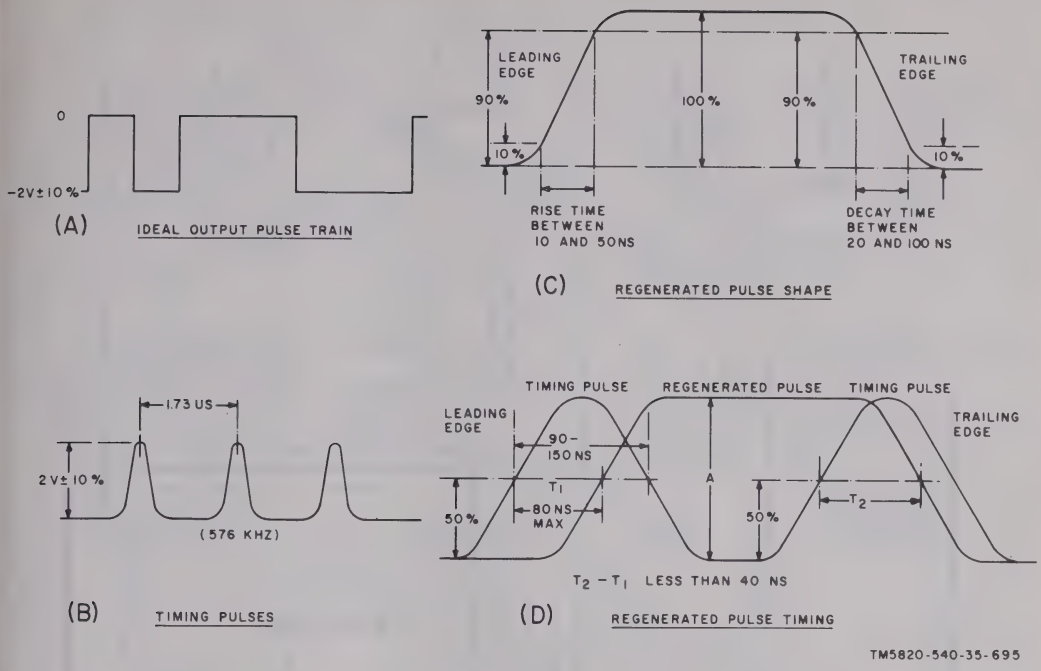


Figure 4–390. Pcm output pulses, oscilloscope display

1. The rise time should be between 10 and 50 nanoseconds and the fall time between 20 and 100 nanoseconds (C, fig. 4–390).

2. The timing pulse width (T2) should be between 90 and 150 nanoseconds at 50 percent amplitude.

3. The timing pulse rise time (10 to 90 percent amplitude) should be between 10 and 50 nanoseconds.

4. The timing pulse position relative to the regenerated pulse at 50 percent amplitude points (T1) should be less than 80 nanoseconds (D, fig. 4–390).

5. The difference T2–T1 should be less than 40 nanoseconds.

(6) *Order wire net gain measurement.*

(*a*) Connect the test equipment as shown in A, figure 4–391.

NOTE

Leave the transmitter tuned to channel 1340 and the receiver to channel 1240 as in the previous test.

(*b*) Set the signal generator to 50 MHz as shown on the frequency meter and adjust the output level for a VTVM noise level indication as recorded in (3)(*a*)4 above (corresponding to a received signal of —74 dbm).

(*c*) Connect the test equipment as shown in B, figure 4–391.

(*d*) Set the coaxial switch to position 2.

(*e*) Set the wide range oscillator to 1 kHz and adjust the output level to —10 dbm as indicated on the VTVM.

(*f*) Set the coaxial switch to position 1. The VTVM should indicate —10 dbm +2.5 db —1.5 db. The 1-kHz tone should be heard on the order wire handset.

(7) *Order wire deviation test.*

(*a*) Connect the test equipment as shown in figure 4–392.

NOTE

Leave the transmitter tuned to channel 1340 and the receiver to channel 1240 as in the previous test.

(*b*) Set the coaxial switch in position 1.

(*c*) Set the wide range oscillator to 1 kHz

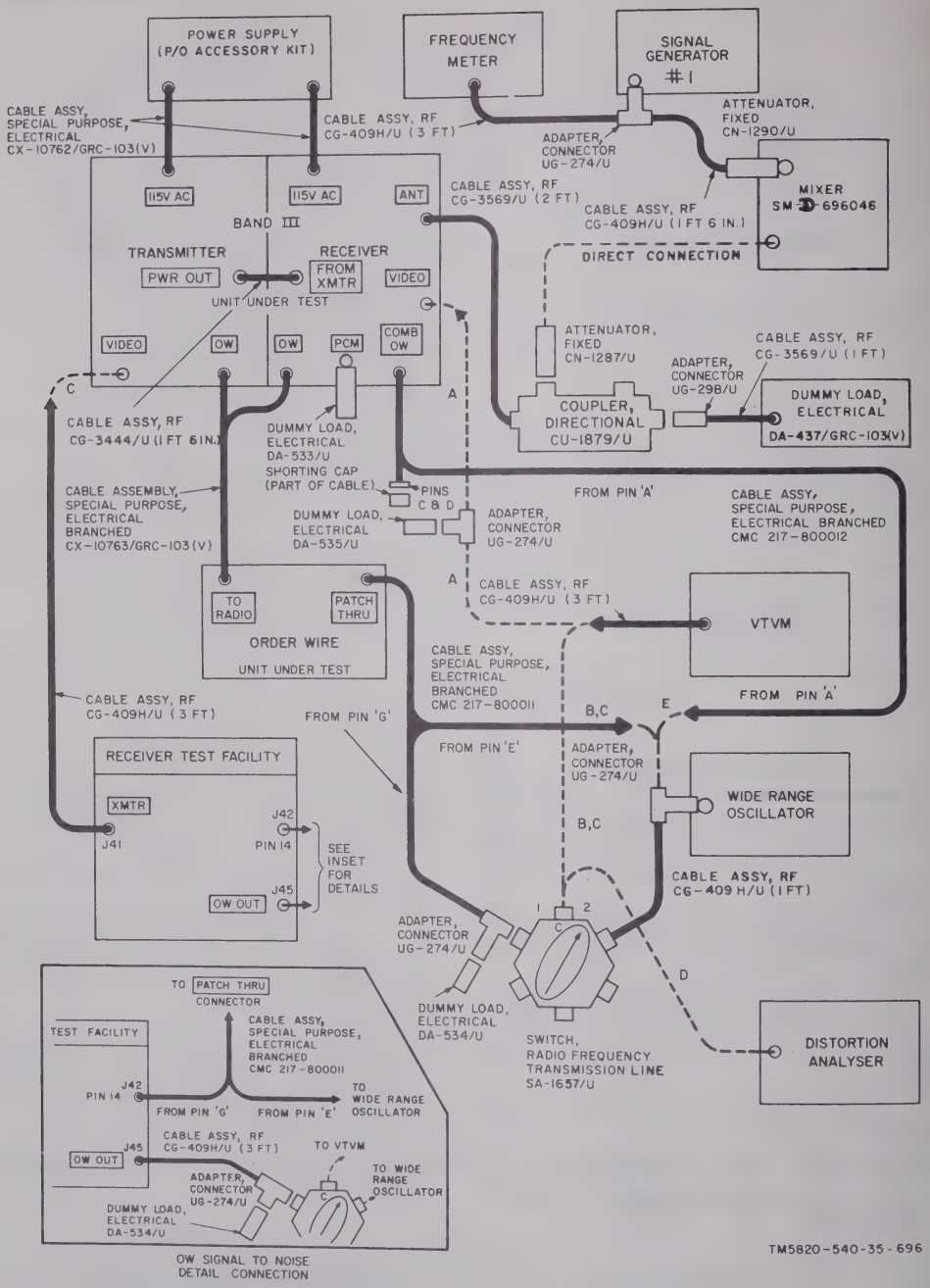


Figure 4-391. Order wire gain, noise level and distortion measurement, test setup.

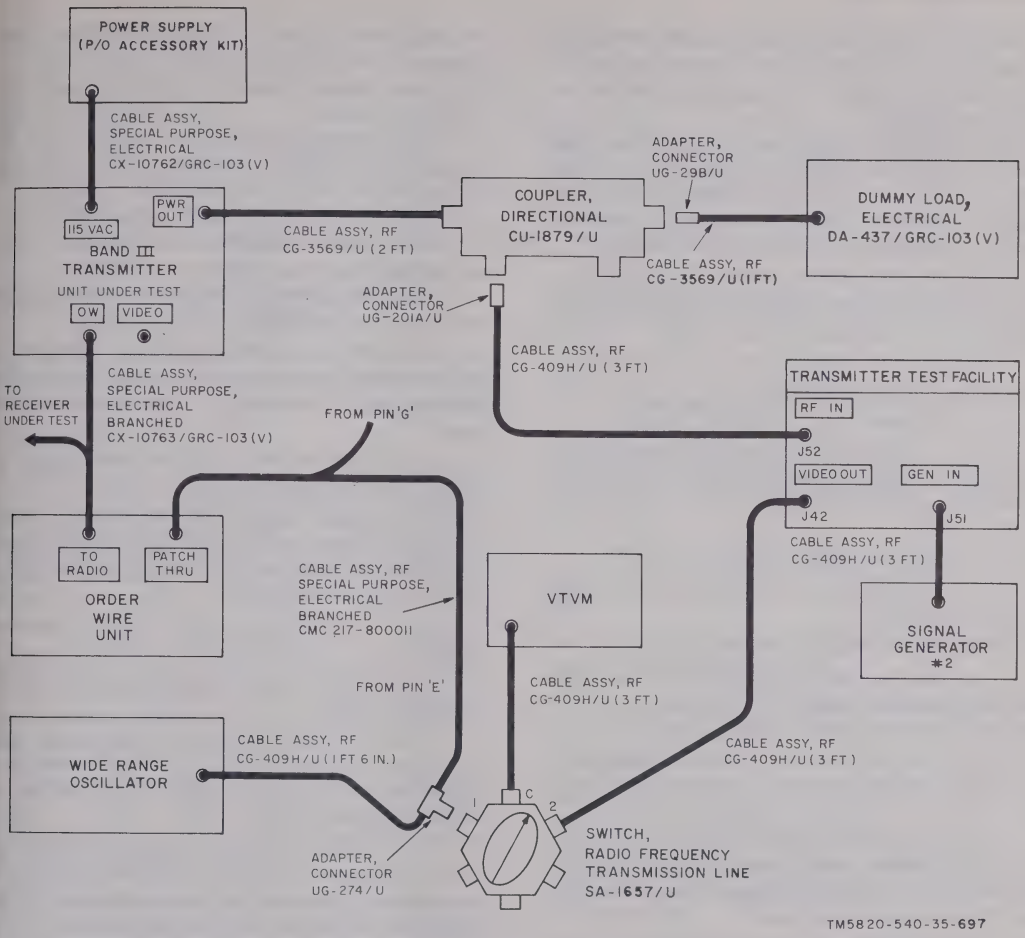


Figure 4–392. Order wire deviation, test setup.

and adjust the output level for a —10 dbm indication on the VTVM.

(*d*) Set the transmitter test facility switches S1 to ON and S20 to 30 MHZ DISCR.

(*e*) Set the coaxial switch to position 2.

(*f*) Set signal generator No. 2 frequency to 870 MHz at an output level of 0 dbm.

(*g*) Observe test facility meter M1 and fine tune the signal generator for a peak indication. Adjust the attenuator on the signal generator to maintain M1 indication at 50 percent full scale. Further tune signal generator for a midscale indication on test facility meter M2. The deviation as indicated by the unterminated VTVM should be between 39 and 58 mv rms (1 mv rms = 1kHz peak deviation).

(8) *Order wire 12-channel pcm test.*

(*a*) Connect the test equipment as shown in C, figure 4–391.

(*b*) Set the coaxial switch to position 2.

(*c*) Set the wide range oscillator to 1 kHz (use the frequency meter) at an output of —10 dbm as indicated on the VTVM.

(*d*) Set the coaxial switch to position 1. The VTVM should indicate —10 dbm +2.5 —1.5 db.

(*e*) Set the test facility switches S1 to ON and S15 to NOISE.

(*f*) Set the transmitter and receiver meter selector switch to 12 CH PCM and the transmitter INPUT control to midrange.

(*g*) Adjust the test facility PCM LEVEL

control for 50 percent indication on the transmitter meter. The receiver meter should indicate in the green band. The VTVM indication should be —10 dbm ± 2 db.

(*h*) Temporarily remove the 91-ohm load from the receiver PCM connector. The receiver meter should drop to zero. Replace the 91-ohm load on the receiver PCM connector. The receiver meter should indicate within the green band.

(*i*) Set the coaxial switch to position 2.

(*j*) Increase the wide range oscillator output to 0 dbm as indicated on the VTVM.

(*k*) Set the coaxial switch to position 1. Record the VTVM indication.

(*l*) Not used.

(*m*) Disconnect the cable connection at transmitter VIDEO connector. The VTVM should be within ± 1 db of indication recorded in (*k*) above.

(9) *Order wire 24-channel pcm test.*

(*a*) Connect the test equipment as shown in C, figure 4–391.

(*b*) Set the coaxial switch to position 2.

(*c*) Set the wide range oscillator to 1 kHz (use the frequency meter) at an output of —10 dbm as indicated on the VTVM.

(*d*) Set the coaxial switch to position 1. The VTVM should indicate —10 dbm +2.5 —1.5 db.

(*e*) Temporarily shortcircuit leads C and D of the COMB OW special cable CMC 217–800012 (fig. 5–18). The VTVM indication should drop to zero. Remove the shortcircuit.

(*f*) Disconnect the pin E lead of the PATCH THRU special cable CMC 217–800011 (fig. 5–18) from the wide range oscillator.

(*g*) Connect the pin A lead of the COMB OW special cable to the wide range oscillator (E, fig. 4–391).

(*h*) Set the coaxial switch to position 2.

(*i*) Set the wide range oscillator to 1.0 kHz and adjust the output level to —4 dbm as indicated on the VTVM.

(*j*) Shortcircuit leads C and D of the COMB OW special cable.

(*k*) Set the coaxial switch to position 1. The VTVM indication should be —10 dbm ± 2 db.

(*l*) Not used.

(*m*) Remove the shortcircuit between lead C and D of the COMB OW special cable. The VTVM indication should drop to zero.

(10) *Order wire harmonic distortion measurement.*

(*a*) Connect the test equipment as shown in B, figure 4–391.

(*b*) Disconnect the test facility from the transmitter VIDEO connector and remove the 91-ohm load from the receiver PCM connector.

(*c*) Set the coaxial switch to position 2.

(*d*) Set the wide range oscillator to 1 kHz and adjust the output level to —10 dbm.

(*e*) Replace the VTVM with the distortion analyzer (D, fig. 4–391).

(*f*) Set the coaxial switch to position 1. The harmonic level should be at least 26 db below fundamental as measured on the distortion analyzer.

(*g*) Replace the distortion analyzer with the VTVM as shown in B, figure 4–391.

(*h*) Repeat steps (*c*) through (*f*) above for a wide range oscillator output level of —5 dbm. The harmonic level should still be more than 26 db below the fundamental.

(11) *Order wire signal-to-noise measurement.*

(*a*) Connect the test equipment as shown in A, figure 4–391.

(*b*) Set signal generator No. 1 to 50 MHz and adjust the output for a VTVM noise level indication as in (3)(*a*)*5* above (corresponding to —94 dbm signal level).

(*c*) Connect the test equipment as shown in C, figure 4–391 and connect the test facility and the order wire unit to the coaxial switch as shown in the test facility detail connection inset.

(*d*) Set the deviation level as follows:

1. Set the test facility switches S1 to ON and S15 to NOISE.

2. Set the transmitter meter selector switch to 12 CH PCM and the INPUT control to midrange.

3. Disconnect the wide range oscillator.

4. Adjust the test facility PCM level control for a 5 percent indication on the transmitter meter.

5. Reconnect the wide range oscillator to the coaxial switch as in C, figure 4–391.

(*e*) Set the coaxial switch to position 2.

(*f*) Set the wide range oscillator to 1 kHz at a level of —10 dbm as indicated on the VTVM.

(*g*) Set the coaxial switch to position 1. Record the VTVM indication.

(*h*) Disconnect the wide range oscillator at the T-connector. The VTVM should indicate at

least 29 db below the level obtained in (*g*) above.

(*i*) Reconnect the wide range oscillator.

(*j*) Disconnect the test facility from transmitter VIDEO connector.

(*k*) Repeat steps (*g*) and (*h*) above. The difference between the two VTVM indications should be greater than 40 db.

(*l*) Not used.

(*m*) Repeat steps (*a*) through (*j*) above at signal levels of —74 dbm and —54 dbm as indicated by VTVM noise levels measured in (3)(*a*)4 and (4)(*d*) above respectively.

Section X. REMOVAL AND REPLACEMENT PROCEDURES—BAND III RF HEADS

4–193. Replacement of Connector-Filter Assembly 38AR1A1W1A1

Connector-filter assembly 38AR1A1W1A1 must be removed in order to replace individual filter connectors or to repair or replace P1 (38AR1A1W1A1).

a. Place the transmitter RF head 38 right side up and locate voltage regulator assembly 38AR1A1A1 (fig. 3–62). Loosen the four green-circled mounting screws on the voltage regulator assembly 38AR1A1A1 and remove the voltage regulator assembly.

b. Locate connector-filter assembly 38AR1A1W1A1 (fig. 3–62). Measure as accurately as possible and record the distance from front panel 38MP1 to the rear edge of 38AR1A1W1A1.

c. Remove the four red-circled screws that secure the connector-filter assembly 38AR1A1W1A1 to the chassis. Carefully remove the connector-filter assembly.

d. If the connector-filter assembly must be replaced, unsolder and tag the wires connected to filters FL1 to FL46. Remove the defective connector-filter assembly and resolder the tagged wires to the replacement connector filter assembly (fig. 8–1).

e. If a single filter must be changed, unsolder the wires from both sides of the filter and remove the filter. Install the replacement filter; connect and solder the wires removed from the defective filter.

f. Refer to paragraph 4–10 for replacement of connectors.

g. Replace connector-filter assembly 38AR1A1W1A1 using the four mounting screws provided. Position 38AR1A1W1A1 at the same distance as measured in *a* above and check the vertical plane of connector P1 using a small square and the top edge of 38AR1 chassis as a reference. Tighten the four mounting screws.

h. Reinstall the voltage regulator assembly 38AR1A1A1 and tighten the four mounting screws.

4–194. Replacement of Radio Interference Filter 38AR1A1FL2

a. Place transmitter RF head right side up and locate radio interference filter 38AR1A1FL2 (fig. 3–62).

b. Remove the two screws securing the red cover plate to the filter; remove the red cover plate.

c. Unsolder and tag the three wires from connecting pins E1, E2 and E3.

d. Remove the two screws securing the radio interference filter and remove the defective radio interference filter.

e. Position the replacement filter and secure it with the two mounting screws.

f. Remove the two screws securing the red cover plate on the replacement filter; remove the red cover plate.

g. Place a suitable length of heat shrinkable tubing type CMC 334–362/3 over each wire to be connected to E1, E2 and E3.

h. Wrap the wires around both sides of the hook in the terminals on the radio interference filter. Ensure a good mechanical connection and solder leads to the terminals.

i. Position the heat shrinkable tubing over the soldered terminals. Use a thermogun to shrink the tubing over the terminals.

j. Replace the red cover plate and secure it with two screws.

4–195. Replacement of Control Panel 38MP1

a. Removal Procedure.

(1) Remove the XMTR TUNE control knob.

(2) Remove the hexagon nut and the flat washer from the PWR OUT connector.

(3) Loosen the two screws that secure plug P1 (38AR1A1W1J3) (fig. 3–60) to its mating connector 38AR1A1W1J3 and disconnect the plug.

(4) Loosen and remove the six green-circled mounting screws and washers located at the rear of the control panel, and remove the control panel.

NOTE

Pull the panel forward from the RF head to release it from the guiding pin.

b. Replacement Procedure.

(1) Place the control panel in position and press to slide home the guiding pin.

NOTE

It may be necessary to loosen the four screws holding power monitor 38AR1A2 (fig. 3–62) in position. Do not retighten screws at this time.

(2) Secure the control panel to the chassis using the six mounting screws removed in *a*(4) above.

(3) Connect P1 (38AR1A1W1J3) of the control indicator 38A2 to its mating connector 38AR1A1W1J3 and secure it in position with the two screws provided.

(4) Replace and secure the nut and washer to the PWR OUT connector. Tighten the power monitor 38AR1A2 mounting screws.

(5) Install the XMTR TUNE control panel knob.

4–196. Replacement of Channel Frequency Indicator 38AR1AR1DS1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Wattmeter AN/URM–120	Wattmeter
Frequency Meter AN/USM–159.	Frequency meter

b. Removal and Replacement Procedure.

(1) Remove the control panel 38MP1 as described in paragraph 4–195.

(2) Reconnect the XMTR TUNE knob to the shaft of the XMTR TUNE control. Turn the XMTR TUNE control fully clockwise to the stop.

(3) Locate the channel frequency indicator 38AR1AR1DS1 (fig. 3–64). Remove the three red-circled screws that secure the channel frequency indicator to the chassis.

(4) Grasp the channel frequency indicator and slide it sideways to disengage the flexible shaft from the hexagonal shaft. Remove the defective channel frequency indicator.

(5) Remove the pin that secures the flexible shaft to the channel frequency indicator. Remove the flexible shaft from the defective channel frequency indicator.

(6) Slide the flexible shaft on the hexagonal shaft.

(7) Turn the replacement channel frequency indicator until the white cross hatch (above channel 1610) on the tape is aligned with the calibration mark (notch) on the frame.

(8) Slide the replacement channel frequency indicator sideways to connect the shaft of the channel frequency indicator to the free end of the flexible shaft.

(9) Secure the channel frequency indicator to the chassis with the three mounting screws.

(10) Position the flexible shaft midway between the channel frequency indicator and the hexagonal shaft. Secure the flexible shaft to the channel frequency indicator using the setscrews. (Do not drill and pin flexible shaft in position at this time.)

c. Channel Alignment Check and Adjustment.

(1) Connect control indicator plug P1 (38AR1A1W1J3) (fig. 3–60) on the control panel to connector 38AR1A1W1J3 on the transmitter RF head chassis.

(2) Connect the test equipment as shown in A, figure 4–313.

(3) Turn XMTR CHANNEL control to channel 990 (695 MHz).

(4) Turn XMTR TUNE control to channel 990.

(5) Set test facility switches S1 to ON, S20 to S12 and S12 to OSC.

(6) Adjust the XMTR TUNE control for a maximum power indication on the wattmeter.

(7) Check the channel frequency indicator. Channel 990 should not be more than ⅛ inch above or below the calibration mark (notch) on 38AR1AR1DS1.

(8) If the channel frequency indication is more than ⅛ inch away from the calibration

mark, loosen the two setscrews holding the flexible shaft to the channel frequency indicator. Adjust the channel frequency indicator until channel 990 is in line with the calibration mark.

NOTE

Insure that the flexible shaft does not move during this adjustment.

(9) Tighten the two setscrews to secure the flexible shaft to the channel frequency indicator. Drill through the channel frequency indicator shaft using the pilot hole provided in the flexible shaft. Press the pin through.

(10) Check the alignment at channels 1050, 1150, 1250 and 1610 as shown in steps (3), (4) and (6) above. Insure that the channel number being checked is not more than ½ inch above or below the calibration mark.

(11) Remove the XMTR TUNE knob and disconnect P1 (38AR1A1W1J3) from connector 38AR1A1W1J3. Install control panel 38MP1 as described in paragraph 4–195.

4–197. Replacement of Resistor Assembly 38AR1A1A2

a. Turn transmitter RF head left side up and locate resistor assembly 38AR1A1A2 (fig. 3–64).

b. Unsolder and tag leads connected to terminal E1.

c. Remove the two green-circled screws that secure the resistor assembly 38AR1A1A2 to the chassis; remove the resistor assembly.

d. Secure the replacement resistor assembly to the chassis using the two mounting screws.

e. Place a suitable length of heat shrinkable tubing type CMC 334–362/3 over the wires removed in *b* above.

f. Connect and solder the wires to the terminal E1. Position the heat shrinkable tubing over the terminal. Use a thermogun to shrink the tubing over the terminal.

4–198. Replacement of Amplifier-Frequency Multiplier 38A1

a. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Wattmeter AN/URM–120	Wattmeter

b. Removal and Replacement Procedure.

(1) Place the transmitter RF head upright and locate amplifier-frequency multiplier 38A1 (fig. 3–62). Disconnect the 38AR1W1A1P2 and P1 (38A1J2) RF leads (fig. 3–60) connected to amplifier-frequency multiplier.

(2) Locate idler sprocket bracket (fig. 4–314) of the frequency multiplier drive chain. Loosen the two screws securing the idler sprocket bracket.

(3) Facing the front panel of the unit, push the idler sprocket bracket toward the right to loosen the drive chain. Remove the chain from the frequency multiplier sprocket.

(4) Loosen the four red-circled mounting screws that secure the amplifier-frequency multiplier 38A1 to the chassis.

(5) Lift the amplifier-frequency multiplier 38A1 straight up, carefully disengaging P1 (38AR1A1W1J2) from its mating connector.

NOTE

The 38A1 replacement module is pinned at channel 1600 (1000 MHz). Do not remove the pin until the module is secured in the transmitter with the drive chain engaged.

(6) To install the replacement amplifier-frequency multiplier 38A1, lower the replacement module down, carefully engaging mating connectors 38AR1A1W1J2 and P1 (38AR1A1W1J2).

(7) Install and tighten the four mounting screws.

(8) Connect RF leads 38AR1W1A1P2 and P1 (38A1J2) to connectors 38A1J1 and 38A1J2 (fig. 3–60) respectively.

(9) Set the transmitter RF head XMTR TUNE and XMTR CHANNEL controls to channel 1600.

(10) Place the drive chain over the frequency multiplier 38A1 sprocket.

(11) Tighten the chain by adjusting the position of the idler sprocket bracket. Tighten the two screws to secure the bracket in place.

(12) Remove the shouldered pin from the frequency multiplier sprocket.

c. Alignment Check.

(1) Connect the equipment as shown in figure 4–393.

(2) Direct cooling air from the AIR OUTLET of the transmitter test facility to the rear of the unit under test.

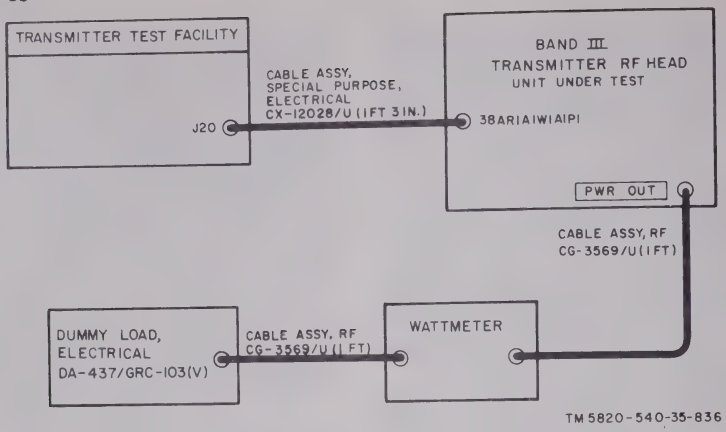


Figure 4–393. Amplifier-frequency multiplier 38A1 alignment check, test setup.

(3) With the XMTR TUNE and XMTR CHANNEL controls set to channel 1600, set the test facility switches as follows:

Switch	Switch position	Normal indication
S1	ON	
S13	ON	
S20	S12	
S12	OSC	Meter M1 indicates between 20% and 90% of full scale.

(4) Turn test facility switch S12 to PWR OUT and adjust the transmitter XMTR TUNE control for maximum indication on the test facility meter M1. The wattmeter should indicate at least 20 watts and the XMTR TUNE channel indication should be within 0.5 inch of the display window centerline.

(5) Repeat step (4) above with the XMTR TUNE and XMTR CHANNEL controls set to channels 990, 1000, 1080, 1160, 1240, 1279, 1280, 1320, 1400, 1480, and 1540.

(6) If required, select the channel giving the highest error above ± 0.5 inch on the XMTR TUNE channel indicator tape. Set the XMTR CHANNEL and XMTR TUNE controls to the channel selected and proceed as follows:

(*a*) Set the test facility switch S12 to MULT and tune the XMTR TUNE control for maximum indication on the test facility meter M1.

(*b*) Loosen the idler sprocket bracket. Disengage the drive chain from the amplifier-frequency multiplier drive sprocket without disturbing the position of the sprocket.

(*c*) Turn the XMTR TUNE control until the channel selected in step (6) above is on the window centerline.

(*d*) Replace the chain over the drive sprocket and tighten the idler sprocket bracket.

(*e*) Repeat steps (4) and (5) above.

4–199. Replacement of RF Amplifier 38AR1AR1

a. Removal Procedure.

(1) To remove radio frequency amplifier 38AR1AR1 the following modules must be removed first:

Low-pass filter 38AR1A1FL1 (para 3–126).
RF power monitor 38AR1A2 (para 3–127).
Voltage regulator assembly 38AR1A1A1 (para 3–128).
Connector filter assembly 38AR1A1W1A1 (para 4–193).
Radio interference filter 38AR1A1FL2 (para 4–194).
Control panel 38MP1 (para 4–195).
Channel frequency indicator 38AR1AR1DS1 (para 4–196).
Resistor assembly 38AR1A1A2 (para 4–197).
Amplifier frequency multiplier 38A1 (para 4–198).
Circulator 38AR1HY1 and electrical dummy load 38AR1AT1 (para 4–200).

(2) Remove the mounting screws on chassis connectors 38AR1A1W1J2, 38AR1A1W1J3, 38AR1A1W1J4 (fig. 3–60) and 38AR1A1W1J5. Remove the connectors complete with wiring harness.

(3) Unsolder and tag wires from 38AR1AR1C7 (fig. 3-60) and 38AR1AR1C14 (fig. 3-62).

(4) Remove the clips holding the rigid cables to the chassis, and remove the rigid cables.

(5) Remove a link from the frequency multiplier 38A1 chain and remove the chain.

(6) Remove the two pins that secure the electronic component assembly chassis 38AR1A1MP7 to the center plate (fig. 3-64).

(7) Remove three red-circled screws holding 38AR1A1MP7 to the center plate.

(8) Remove the four red-circled mounting screws securing 38AR1A1MP7 to the rear plate.

(9) Pull the electronic component assembly chassis 38AR1A1MP7 away from the radio frequency amplifier 38AR1AR1.

b. Replacement Procedure.

(1) Replace the link on the chain of the frequency multiplier 38A1.

(2) Place electronic component assembly chassis 38AR1A1MP7 in its position over the radio frequency amplifier 38AR1AR1 and secure it to the center plate with two pins.

(3) Replcce the three red-circled screws that secure the electronic component assembly chassis to the center plate.

(4) Secure the chassis to the rear plate with four red-circled screws.

(5) Replace the rigid cables in position and secure them to the chassis with the clips removed in *a*(5) above.

(6) Slide a piece of heat shrinkable tubing CMC 334-362/3 over each of the two wires connected to 38AR1AR1C7 (fig. 3-60) and 38AR1AR1C14 (fig. 3-62) and solder these to their respective capacitors. Slide the tubing over the soldered portions and shrink it with a thermogun.

(7) Position chassis connectors 38AR1A1W1J2, 38AR1A1W1J3, 38AR1A1W1J4 and 38AR1A1W1J5 in their respective places. Secure in position with the mounting screws provided.

(8) Replace the following modules in the order given:

Circulator 38AR1HY1 and electrical dummy load 38AR1AT1 (para 4-200).

Amplifier frequency multiplier 38A1 (para 4-198).

Resistor assembly 38AR1A1A2 (para 4-197).

Channel frequency indicator 38AR1AR1DS1 (para 4-196).

Control panel 38MP1 (para 4-195).

Radio interference filter 38AR1A1FL2 (para 4-194).

Connector-filter assembly 38AR1A1W1A1 (para 4-193).

Voltage regulator assembly 38AR1A1A1 (para 3-128).

RF power monitor 38AR1A2 (para 3-127).

Low-pass filter 38AR1A1FL1 (para 3-126).

(9) Repeat paragraph 4-198*c*.

4-200. Replacement of Circulator 38AR1HY1 and Electrical Dummy Load 38AR1AT1

a. Replacement of Circulator 38AR1HY1.

NOTE

Amplifier frequency multiplier 38A1 must be removed in order to give access to the mounting screws of circulator 38AR1HY1. Refer to paragraph 4-198 for the removal of amplifier-frequency multiplier 38A1.

(1) Place the transmitter RF head bottom side up and locate circulator 38AR1HY1 (fig. 3-64). Remove the RF leads connected to the circulator.

(2) Place the transmitter RF head upright. Locate and remove the four mounting screws which secure the circulator 38AR1HY1 to the chassis.

(3) Remove the defective circulator.

(4) To install the replacement circulator 38AR1HY1 position the replacement module on the mounting holes and tighten the four mounting screws.

(5) Connect P2 plug of 38AR1W1 to J1 connector of circulator 38AR1HY1, P1 plug of 38AR1W2 to J2 connector and P1 of 38AR1W4 to J3 connector.

b. Replacement of Electrical Dummy Load 38AR1AT1.

(1) Remove control panel as described in paragraph 4-195.

(2) Locate the electrical dummy load 38AR1AT1 (fig. 3-60) and disconnect the RF lead from connector J1.

(3) Remove the two mounting screws that secure the dummy load to the chassis and remove the defective electrical dummy load.

(4) To install the replacement module, place the electrical dummy load on its mounting holes and secure it with two mounting screws.

(5) Connect P2 of RF lead 38AR1W4 to connector J1 of electrical load 38AR1AT1.

(6) Replace control panel 38MP1 (para 4-195).

4-201. Replacement of Signal Distribution Radio Panel 34A6

a. Place the receiver RF head upright and locate signal distribution radio panel (control panel) 34A6 (fig. 3-69).

b. Locate and loosen the two screws that secure P1 (34A1W1J5) to 34A1W1J5 (fig. 3-69); remove P1 (34A1W1J5).

c. Loosen the screws in the MULT PEAK, RCVR SIG and XMTR DUPL control panel knobs and remove the knobs.

d. Using a socket wrench, remove the two nuts that secure the ANT. and FROM XMTR connectors to the control panel. Pull the connectors away from the control panel.

e. Loosen the eight mounting screws that secure control panel 34A6 to the chassis. Remove the control panel.

f. To reinstall 34A6, place the control panel in the correct position on the chassis so that the mounting holes are properly aligned. Secure control panel 34A6 with the eight mounting screws.

g. Insert the connectors through the ANT. and FROM XMTR mounting holes and secure them with the nuts and washers removed in *d* above.

h. Replace and secure the MULT PEAK, RCVR SIG and XMTR DUPL control knobs. Make sure that the backs of the RCVR SIG and XMTR DUPL knobs clear the control panel by 1/8 inch.

i. Connect P1 (34A1W1J5) to 34A1W1J5 and secure the plug in position with the two mounting screws.

4-202. Replacement of Channel Frequency Indicator 34A1A1DS1 or 34A1A1DS2

a. Remove control panel 34A6 as described in paragraph 4-201.

b. Remove the three red-circled mounting screws that secure the defective channel frequency indicator 34A1A1DS1 or 34A1A1DS2 (fig. 4-342) to the chassis.

c. Grasp channel indicator and slide it sideways to disengage the flexible shaft. Remove the defective channel frequency indicator.

d. Remove the pin through the flexible shaft and remove the flexible shaft from the defective channel frequency indicator.

e. Install the flexible shaft on the replacement channel frequency indicator and secure with a setscrew.

f. Install the RCVR SIG control knob if 34A1A1DS1 is being replaced, or the XMTR CHANNEL control knob if 34A1A1DS2 is being replaced.

g. Turn the control knob fully clockwise to the stop position.

h. Turn the flexible shaft, on the replacement channel frequency indicator, clockwise until the start position, indicated by an arrow head and the letters "RS" for 34A1A1DS1 and "TS" for 34A1A1DS2, is aligned with the calibration mark. The calibration mark is a notch centrally located on the front edge of the unit's frame.

i. Place the channel frequency indicator in position and slip the hexagonal recessed end of the flexible shaft over the associated coupling shaft (fig. 4-342).

j. If the stop position of the channel control and the start position on the tape do not coincide, proceed as follows:

(1) Loosen the setscrew in the flexible shaft.

(2) Insure that the channel control is turned fully clockwise.

(3) Adjust the tape to realign the start position as in step *h* above.

(4) Retighten the setscrew securing the flexible shaft.

k. Remove the channel frequency indicator. Using the guide holes in the flexible shaft, drill a hole through the channel frequency indicator shaft. Press a pin through both shafts. Remove the setscrew.

(*l*) Not used.

(*m*) Reinstall the channel frequency indicator and secure in position with the three mounting screws.

4–203. Replacement of RF Power Monitor 34A3

NOTE

Signal distribution radio panel 34A6 must be removed (para 4–201) in order to permit replacement of RF power monitor 34A3.

a. Place the receiver RF head front side up and locate the RF power monitor 34A3 (fig. 3–76).

b. Locate and loosen the two screws that secure P1 (34A1W1J3) to 34A1W1J3 (fig. 4–342). Remove P1 (34A1W1J3) plug.

c. Disconnect the two RF leads from the J1 and J2 connectors of 34A3.

d. Locate and unscrew the four mounting screws that secure the RF power monitor to the chassis.

e. Lift the RF power monitor complete with cable from the chassis.

f. To install the replacement module, position 3A43 in its place and secure it with the four mounting screws.

g. Connect P1 (34A3J2) RF leads to connector J2 and P2 (34A3J1) RF lead to connector J1 of RF power monitor 34A3.

h. Connect P1 (34A1W1J3) plug to 34A1W1J3 chassis connector. Secure in position with the screws provided.

i. Replace signal distribution radio panel 34A6 (para 4–201).

4–204. Replacement of Connector-Filter Assembly 34A1W1A1

a. Place the receiver RF head rear side up and locate connector filter assembly 34A1W1A1 (fig. 5–34).

CAUTION

The two locating pins on the sides of 34A1W1A1 are factory aligned and should never be loosened or removed.

b. Remove the four screws that secure 34A1W1A1 to the chassis. Pull 34A1W1A1 free of the chassis.

c. Replace filter-connectors as required. Refer to paragraph 4–9 and figure 8–7 for replacement of filter-connectors.

d. If 34A1W1A1P1 requires replacement, unsolder and tag the wires from the pins.

e. Remove the four screws that secure 34A1W1P1 to the assembly; remove 34A1W1P1 from the assembly.

f. Install the replacement 34A1W1P1 and secure it with the four mounting screws provided.

g. Connect and solder the wires removed in *d* above.

h. Place 34A1W1A1 in position on the chassis and secure it with the four screws removed in *b* above.

4–205. Replacement of Speed Decreaser Gear Assembly 34A1MP1

a. Loosen the screws in the MULT PEAK knob on the front panel. Remove the knob.

b. Loosen the two screws in the coupling shaft (fig. 3–69) that secure the speed decreaser gear assembly shaft.

c. Place the receiver RF head right side up and locate the speed decreaser gear assembly 34A1MP1 (fig. 3–73). Unscrew the three red-circled screws and remove the speed decreaser gear assembly 34A1MP1.

d. To install the replacement speed decreaser gear assembly 34A1MP1, place it in position over the three mounting holes. MULT PEAK shaft should extend from the hole in the front panel and the gear speed decreaser shaft should fit into coupling shaft.

e. Tighten the three red-circled mounting screws.

f. Tighten the two screws in the coupling shaft.

g. Replace and secure the MULT PEAK knob.

h. Align the amplifier-converter unit 34 as described in paragraph 4–171*d*.

NOTE

It should not be necessary to perform the alignment procedures of the voltage control assembly 34A1A2.

4–206. Replacement of Frequency Multiplier Group 34A2

a. Place the receiver RF head upright and locate the multiplier group 34A2 (fig. 3–69).

b. Loosen the two setscrews in the coupling shaft (fig. 3–69) end closest to the multiplier group.

c. Disconnect plug P2 (34A1W1J7) (fig. 3–69) from 34A1W1J7.

d. Disconnect RF leads P2 (34W7J1) and P1 (34A1W1A1J2) (fig. 3–69).

e. Place the receiver RF head right side up. Locate and unscrew the four red-circled screws that secure the multiplier group 34A2.

f. Place the receiver RF head left side up. Locate and unscrew the remaining four red-circled mounting screws (fig. 3–76) that hold multiplier group 34A2.

g. Pull the frequency multiplier group 34A2 away from the chassis.

h. To reinstall the replacement module, lower the frequency multiplier group 34A2 into position inserting locating pins into the appropriate holes and engaging the tuning shaft with the coupling shaft. Tighten the eight red-circled screws removed in *d* and *e* above, and the setscrews in the coupling shaft.

i. Connect the RF leads removed in *d* above to their respective connectors.

j. Connect P2 (34A1W1J7) to 34A1W1J7 and secure with the two screws provided.

k. Realign the band III receiver RF head as described in paragraph 4–171*d*.

4–207. Replacement of Frequency Multiplier 34A2A1

a. Place the receiver RF head top side up and locate frequency multiplier 34A2A1 (fig. 3–69).

b. Locate and disconnect RF cable P2 (34A2A1J1) from connector 34A2A1J1 (fig. 3–69).

c. Locate and disconnect P1 (34A2A1J2) (fig. 3–69).

d. Locate and remove the two screws A and B (fig. 4–348). Remove the brass shim located on the clamp.

e. Locate and loosen the three red-circled mounting screws of the frequency multiplier 34A2A1.

f. Lift frequency multiplier 34A2A1 straight up carefully disengaging connector P1 from chassis connector 34A2FL1W1J2.

g. To install frequency multiplier 34A2A1, position the module over the mounting holes carefully engaging P1 to chassis connector 34A2FL1W1J2.

h. Tighten the three red-circled mounting screws.

i. Insert brass shim in position on the clamp. Position the tuning plunger coupling over the shim and secure to the drive mechanism clamp with the two screws.

j. Connect RF lead P2 (34A2A1J1) to 34A2A1J1 and P1 (34A2A1J2) to 34A2A1J2 (fig. 3–69).

k. Disconnect RF leads P1 (34A1W1A1J2) and P2 (34W7J1) (fig. 3–69) from their respective connectors.

(*l*) Not used.

(*m*) Locate and loosen the two screws that secure P2 (34A1W1J7) (fig. 3–69) to chassis connector 34A1W1J7. Disconnect P2 (34A1W1J7).

n. Realign the frequency multiplier group 34A2 as described in paragraph 4–175 *d*. Loosen the clamp and rotate gear A (fig. 3–73) when it is required to turn the 3A42 tuning shaft in the alignment procedure.

o. Reconnect RF leads P1 (34A1W1A1J2) and P2 (34W7J1) and plug P2 (34A1W1J7) into their respective connectors.

p. Realign the frequency multiplier group with the receiver RF head as described in paragraph 1–171 *d*.

4–208. Replacement of Bandpass Filter 34A2FL1 and Terminal Board 34A2FL1W1TB1

a. Remove the following units in the order given below:
Frequency multiplier 34A2A2 (para 3–130).
Frequency multiplier 34A2A1 (para 4–207).

b. Locate and loosen the screws on P2 (34A1W1J7) (fig. 3–69) and disengage it from its mating connector. Disconnect RF leads P1 (34A1W1A1J2) and P2 (34W7J1). Loosen the setscrews in the coupling shaft (fig. 3–69).

c. Place the receiver RF head right side up. Locate and loosen the four red-circled screws of multiplier group 34A2.

d. Place the receiver RF head left side up. Locate and unscrew the remaining four red-circled mounting screws of multiplier group 34A2.

e. Pull bandpass filter 34A2FL1 (multiplier

group 34A2 less frequency multiplier 34A2A1 and frequency multiplier 34A2A2) away from the chassis.

f. Unsolder and tag the wires connected to terminal board 34A2FL1W1TB1 (fig. 4–359).

g. Remove the two mounting screws securing 34A2FL1W1TB1 to the bandpass filter. Remove the terminal board.

h. Position the replacement terminal board on the bandpass filter and secure in pace with the two mounting screws.

i. Solder the wires to the terminals of 34A2FL1W1TB1 (refer to fig. 8–7).

j. Install and secure frequency multiplier 34A2A2 to the bandpass filter (fig. 4–348). Connect RF cable plug P1 (34A2A2J1) to J1 of 34A2A2.

k. Install and secure frequency multiplier 34A2A1 to the bandpass filter 34A2FL1 (para 4–207 *g* through *j*).

(*l*) Not used.

(*m*) Realign the frequency multiplier group as described in paragraph 4–175 *d*.

n. Install and realign the frequency multiplier group with the receiver RF head as described in paragraph 4–206 *h* through *k*.

4–209. Replacement of Voltage Control Assembly 34A1A2

a. Place the receiver RF head right side up and locate voltage control assembly 34A1A2 (fig. 3–73).

b. Locate and loosen the three red-circled mounting screws of voltage controls assembly 34A1A2; lift the module away from the chassis.

c. Unsolder and tag the four wires connected to terminals E1, E2, E3, and E4.

d. To install the replacement module, solder the four wires to terminals E1, E2, E3, and E4 on the replacement module.

e. Position the module in its place and tighten the three red-circled screws.

f. Align the band III receiver RF head as described in paragraph 4–171 *d*.

NOTE

It should not be necessary to perform the alignment procedure of multiplier group 34A2.

4–210. Replacement of Terminal Board 34A1W1TB1

a. Remove intermediate frequency amplifer 34AR1 (para 3–132).

b. Remove frequency mixer stage 34A7 (para 3–133).

c. Locate and loosen the mounting screws of chassis connectors 34A1W1J8 and 34A1W1J9 (fig. 5–34). Push these connectors down through the holes provided in the bottom support.

d. Remove the six mounting screws of the bottom support. Remove the bottom support.

e. Unsolder and tag the wires attached to terminal board 34A1W1TB1.

f. Remove the two mounting screws that secure the defective terminal board.

g. Mount the replacement terminal board in its position and tighten the two screws.

h. Solder the wires to the replacement terminal board. Refer to wiring diagram, figure 8–7, if necessary.

i. Place the bottom support in its position and pull connectors 34A1W1J8 and 34A1W1J9 up through the holes provided.

j. Secure the bottom support with the six mounting screws.

k. Secure the two chassis connectors 34A1W1J8 and 34A1W1J9 to the bottom support with the screws provided.

(*l*) Not used.

(*m*) Replace intermediate frequency amplifier 34AR1 (para 3–132) and frequency mixer stage 34A7 (para 3–133).

CHAPTER V

DEPOT MAINTENANCE

Section 1. INTRODUCTION

5–1. General

This chapter covers depot maintenance for Radio Set AN/GRC–103(V)1. It lists tool and test equipment requirements necessary completely to test and repair the radio set. The tests, repairs, and alignment procedures outlined are a continuation of the maintenance procedures described in chapter 4. Mechanical repair is the prime concern in these procedures and covers the assembly and disassembly of major components of the radio set. Most of the parts in the radio set are readily accessible and easily replaceable without requiring complete disassembly. Use only those portions of the procedures necessary to replace a defective item for any given repair job.

5–2. Test Equipment and Material Required

The following table lists the test equipment, cables, connectors, and tools required for depot maintenance of the radio set.

NOTE

Cables and connectors included in the test facility are not listed in the paragraph.

a. Test Equipment.

Nomenclature	Technical manual	Common name
Test Facility, Transmitter TS-2866(V)1/GRM-95(V)	TM 11-6625-1696-12	Transmitter test facility
Test Facility, Receiver TS-2867(V)1/GRM-95(V)	TM 11-6625-1696-12	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V)	TM 11-6625-1696-12	Accessory kit
Counter, Electronic, Digital Readout AN/USM-207	TM 11-6625-700-10	Counter
Generator, Signal AN/USM-44A	TM 11-6625-508-10	Signal generator
Generator, Signal SG-888/u		Sweep generator
Generator, Thermal Noise SG-419/U	TM 11-6625-413-10	Noise generator
Generator, Signal SG-867/U		Power signal source
Multimeter AN/USM-34 with 11042A probe coax T-connector		Multimeter
Multimeter TS-352B/U	TM 11-6625-366-15	Multimeter
Oscilloscope AN/USM-140	TM 11-6625-535-15-1	Oscilloscope
Oscilloscope AN/USM-281		Oscilloscope
Oven, Temperature-Controlled, Delta Design 6545R		Oven
Power Supply, Power Designs Model 5015A		Power Supply
Synthesizer, Electrical Frequency 1RE1A2 or 5TR1A2		Synthesizer
Tachometer, Stroboscope		Strobotac
Wattmeter AN/URM-98	TS 11-6625-433-15	Power Meter
Wattmeter AN/URM-120	TM 11-6625-446-15	Wattmeter

b. Connectors.

Adapter-connector UG–643/U
Adapter T72757

c. Special Tools.

Allen key 050.
Allen key 035.
Feeler gage 0.003 inch
Retaining ring pliers, Waldes No. 52
Drift pin punch
Test Jig CMC t46338
Open end wrench, 1/2 inch
Torque wrench for 70 ounce/inches

Section II. REPAIR OF AMPLIFIER-FREQUENCY MULTIPLIER AM–4320/GRC–103(V) (TRANSMITTER RF HEAD)

5–3. Replacement of RF Amplifier Subassembly 6AR1A1

a. Removal Procedure.

(1) Remove filter assembly 6AR1A2A4 as described in paragraph 4–87*a*(1) through (5).

(2) Disconnect the following rf leads connected to filter assembly 6AR1A2A4: P1 (6AR1A2A4J2) and P2(6AR1A2A4J4).

(3) Release rf cable P2(6AR1A2A4J4) from rf cable assembly 6AR1W1 by cutting the binding cord.

(4) Locate low pass filter 6AR1A2FL1 and disconnect rf lead P2(XAR1A3J1) (fig. 3–13) and rf lead P1 to 6AR1A1J2 (fig. 3–6).

(5) Disconnect rf lead P2 (6AR1A1J1) from 6AR1A1J1 (fig. 3–6).

(6) Locate power monitor 6AR1A3 (fig. 3–13), remove the four red-circled mounting screws, and remove 6AR1A3.

(7) Unsolder and tag the wires from 6AR1A1FL1, 6AR1A1FL2 (fig. 3–6), 6AR1–A1FL3, and 6AR1A1C15 (fig. 3–13) on the side nearest circuit card assembly 6AR1A2A2.

(8) Remove the six mounting screws shown in figure 4–71. One of the mounting screws is located under the upper right corner of the rubber gasket at the rear of 6AR1A1. Remove the two mounting screws shown in figure 3–6.

(9) Lift and remove the 6AR1 chassis from rf amplifier subassembly 6AR1A1.

b. Replacement Procedure.

(1) Place the 6AR1 chassis on the replacement rf amplifier subassembly 6AR1A1 and secure it in place with the screws removed in *a* (8) above. Do not tighten the two screws located beside connector-filter assembly 6AR1A2A3 (fig. 3–6).

(2) Install power monitor 6AR1A3 but do not tighten the four mounting screws at this time.

(3) Connect plugs P2(XAR1A3J1) to P1 of power monitor 6AR1A3; P2 of 6AR1A2FL1 to 6AR1A1J2; and P2(6AR1A1J1) to J1 of rf amplifier subassembly 6AR1A1.

(4) Connect rf leads P1(6AR1A2A4J2) to J2 of filter assembly 6AR1A2A4 and P2(6AR1A–2A4J4) to J4 of 6AR1A2A4.

(5) Secure P2(6AR1A2A4J4) rf lead to rf cable assembly 6AR1W1 and cable assembly to P2(XW1J1) with a piece of cord.

(6) Connect and solder to 6AR1A1C16 one end of a piece of insulated wire, approximately 2 in. long of similar gauge to the wires in the cable form, with two pieces of heat-shrinkable tubing over each end.

(7) Connect and solder the wires removed from 6AR1A1FL1, 6AR1A1FL2 and 6AR1A1–FL3 in *a*(7) above.

(8) Insert the wire to be connected to 6AR1A1C15 through the heat shrinkable tubing on the free end of the wire connected to 6AR1A1–C16 in (6) above. Connect and solder both wires to 6AR1A1C15.

(9) Position the heat shrinkable tubing on the wires, over 6AR1A1C15 and 6AR1A1C16 terminals and use a thermogun to shrink the tubing to fit snugly over the terminals.

(10) Replace the XMTR TUNE control knob temporarily and tune the transmitter to channel 340. Remove the control knob.

(11) Install the remaining units as described in paragraph 4–87*b*(7) through (12).

(12) Test rf amplifier subassembly 6AR1A1 in the transmitter rf head as described in paragraph 4–29.

5–4. Disassembly and Reassembly of RF Amplifier Subassembly 6AR1A1 Mechanical Tuning Assembly

a. General

(1) Disassemble the unit as far as necessary until the damaged part or parts have been removed. Replace the damaged part or parts and proceed to the appropriate reassembly steps in *c* below. Replace all dowel pins and setscrews that required removal. Each item shown in a figure is assigned an item number. The item numbers are in numerical order in the appropriate parts list at the end of this paragraph, and are followed by a reference symbol and a brief description, for identification of the item for replacement purposes.

(2) To remove a flanged bearing proceed as follows:

(*a*) Use a plastic rod with a diameter less than but close to the diameter of the bearing to be removed.

(*b*) Place the rod against the bearing on the opposite side of the flange. Gently tap the rod with a hammer until the bearing drops out.

(3) When a gear must be replaced, install a new shaft as well. To replace an old gear on a new shaft, proceed as follows:

(*a*) Refer to the parts list and identify the pin, then choose the correct drill size for the pin.

(*b*) Align the gear on the shaft. Hold the gear with one or two setscrews, as required.

(*c*) Drill through one hole in the gear and continue half way through the shaft.

(*d*) Rotate the gear and shaft 180°.

(*e*) Drill through the other hole in the gear and continue through the shaft until the drill meets the hole drilled in (*c*) above.

(*f*) Pin the gear, remove the setscrews, and check for any movement between the gear and shaft.

(4) While pinning a gear, support the gear, whenever possible, in order to absorb undue shock to the bearings which could damage the shaft.

(5) Apply ESSO BEACON No. 325 grease or equivalent to all new leadscrews, and bearing mounting holes.

(6) After electrical tests (para 5–5) have been completed on a repaired unit, apply liquid sealant Loctite grade C or equivalent to all new or replaced setscrews.

b. Disassembly Procedures.

(1) *General*

(*a*) Remove amplifier-frequency multiplier cover 6MP2 from the unit to be repaired.

(*b*) Remove control panel 6MP1 as described in paragraph 4–102.

(*c*) Locate and remove the five screws (1) and washers (2). Remove amplifier cover plate (3), as shown in figure 5–1.

(2) *Removal of XMTR TUNE drive mechanism* (fig. 5–1).

NOTE

Setscrews (11), (23), and (31) are coated with liquid sealant (Loctite grade C). Melt the sealant with a soldering iron if the setscrews are difficult to remove.

(*a*) Remove the two screws (4) and spring washers (5) that hold drive chain idler (6), (7), (8); remove guard (6), screw (7) and sprocket wheel (8).

(*b*) Open the drive chain (9) at the connector link by removing the spring clip.

(*c*) Lift out tuning limit mechanism items (19) through (14).

(*d*) Remove the right hand cathode drive sprocket (16) as follows:

1. Unsolder the filament wire from C13.

2. Loosen setscrew (15); pull out and remove sprocket (16) and woodruff key (17).

(*e*) Remove the left hand cathode drive sprocket (20) as follows:

1. Unsolder the filament wire from C14.

2. Loosen setscrew (19); pull out and remove sprocket (20) and woodruff key (21).

(*f*) Loosen setscrew (23); pull out and remove anode drive sprocket (24) and woodruff key (25).

(*g*) Loosen setscrew (27); pull out and remove anode drive gear (28) and woodruff key (29).

(*h*) Loosen setscrew (31); pull out and remove the right hand anode drive sprocket (32) and woodruff key (33).

(3) *Removal of PWR OUT PEAK drive mechanism* (fig. 5–2).

NOTE

Setscrews (3), (12), (15), (32), (43), (49), and (56) are coated with liquid sealant (Loctite grade C). Melt the sealant with a soldering iron if the setscrews are difficult to remove.

(*a*) Pull out and remove the output coupling probe stop washer assembly, items (1) through (7).

(*b*) Turn spur gear (9) to unscrew the right hand coupling capacitor drive mechanism, items (8) through (14), from threaded ring (16). Remove items (8) through (14).

(*c*) Loosen setscrew (15); remove threaded ring (16) with setscrew (15).

(*d*) Unscrew and remove setscrew (17); remove spring (18) and ball (19).

(*e*) Pull out and remove clutch control mechanism items (20) thru (28).

(*f*) Loosen setscrew (32); pull out and remove shaft (31) with bearing (29) and retaining ring (30). Remove released gear (33) and bearing (34).

(*g*) Support bevel gear (46) and remove dowel pin (45); pull out bevel gear (46).

(*h*) Loosen setscrew (43) holding ring (44); slide shaft (38) towards the right and remove released items (39) through (44).

(*i*) Push out ball bearings (37) and (47).

(*j*) Turn bevel gear (51) to unscrew left hand coupling capacitor drive mechanism items (48) through (55) from threaded ring (57). Remove items (48) through (55).

NOTE

Item (57) cannot be seen in figure 5–2 but is identical to item (16).

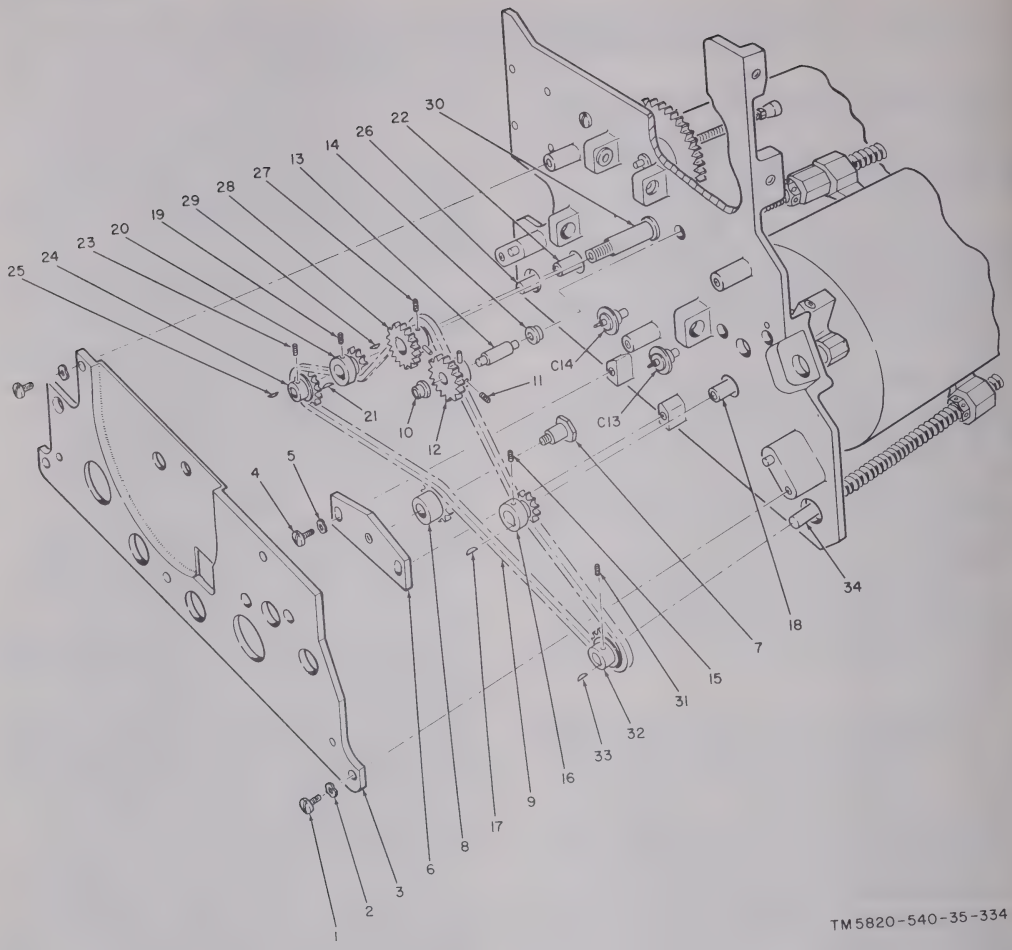


Figure 5-1. Power amplifier subassembly, XMTR TUNE mechanism.

(*k*) Remove threaded ring (57) as follows:

1. Remove filter assembly 6AR1A2A4 as described in paragraph 4–87 *a.*

2. Loosen setscrew (56) and remove threaded ring (57) with setscrew (56).

(4) *Removal of channel frequency indicator 6AR1A1DS1 drive mechanism* (fig. 5–2).

(*a*) Remove the four mounting screws (67) and washers (68); remove frequency channel indicator (69) with flexible shaft (59), secured by setscrew (58).

(*b*) Remove dowel pin (60) and slide shaft (63) out towards the left side of plate (70). Remove released bevel gear (61).

(*c*) Push out the two bearings (62).

(5) *Removal of frequency multiplier 6A2 drive mechanism.*

(*a*) Remove filter assembly 6AR1A1A4 as described in paragraph 4–87*a*(3) through (5).

(*b*) Remove dowel pin (64) from bevel gear (65) (fig. 5–2) and dowel pin (72) from spur gear (71).

(*c*) Pull out the flexible shaft (73) back toward the rear of the unit, and release shaft (66), bevel gear (65), and spur gear (71).

(*d*) Push out sleeve bearing (75).

c. Reassembly Procedures.

(1) *Replacement of XMTR TUNE drive mechanism* (fig. 5–1).

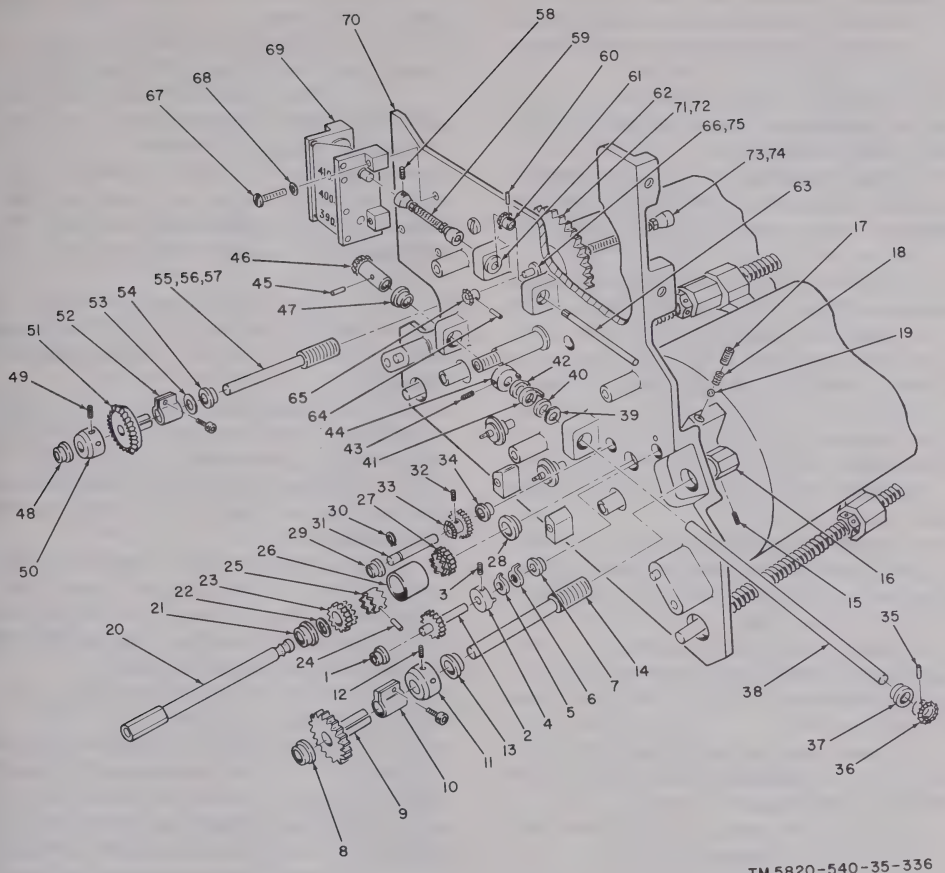


Figure 5-2. Power amplifier, PWR OUT PEAK control, exploded view.

(*a*) Place woodruff key (17) on shaft (18), slide sprocket (16) into place and secure with setscrew (15).

(*b*) Place woodruff key (21) on shaft (22); slide sprocket (20) into place and secure with setscrew (19).

(*c*) Place woodruff key (25) on leadscrew (26), slide sprocket (24) into place and secure with setscrew (23).

(*d*) Place woodruff key (29) on leadscrew (30), slide sprocket (28) into place and secure with setscrew (27).

(*e*) Place woodruff key (33) on leadscrew (34); slide sprocket (32) into place and secure with setscrew (31).

(*f*) Turn sprocket (32) clockwise until a stop position is reached.

(*g*) Counting the number of turns, rotate sprocket (32) counterclockwise until a stop position is reached.

CAUTION

Do not change the position of sprocket (28) while adjusting sprockets (32) and (24).

(*h*) Rotate and set sprocket (32) at half the number of turns counted in (*g*) above.

(*i*) Repeat (*f*), (*g*), and (*h*) above for sprocket (24).

(*j*) Place chain (9) in position and install the connecting link and spring clip. Do not disturb the position of sprockets (24), (28), and (32).

(*k*) Apply grease to the shoulder of screw (7) and apply liquid sealant to the threads. Secure sprocket (8) to guard (6) with shoulder screw (7).

(*l*) Place drive chain idler items (6), (7) and (8) in position and secure with two screws (4) and spring washers (5).

(*m*) Using sprocket (8) as a reference adjust sprockets (16), (20), (24), (28), and (32) so that chain (9) is level with plate (70) (fig. 5–2).

(*n*) Tighten, then apply liquid sealant to, setscrews (23), (27), and (31) (fig. 5–1).

(*o*) Assemble bearing (14), shaft (13), spur gear (12), and bearing (10) in that order. Secure spur gear (12) to the shaft with setscrew (11).

(*p*) Solder the filament wire protruding from shaft (18) to C13.

(*q*) Solder the filament wire protruding from shaft (22) to C14.

(*r*) Apply oil "ESSO UNIVIS" or equivalent to chain (9) and adjust the chain tension by repositioning sprocket wheel (8); secure in position with screws (4).

(*s*) Install cover plate (3) and secure with the five screws (1) and spring washers (2).

(2) *Replacement of PWR OUT PEAK drive mechanism* (fig. 5–2).

(*a*) Place the threaded ring (57) with setscrew (56) on the left hand cavity PWR OUT PEAK control shaft.

(*b*) Grease the threads of leadscrew (55); screw item (55) into threaded ring (57).

NOTE

Items (57) and setscrew (56) are not seen on figure 5–2. These items are identical to items (16) and (15) of the right hand cavity.

(*c*) Install, in order, items (54) through (48) on leadscrew (55).

(*d*) Press bearings (37) and (47) into place on the mounting holes in plate (70).

(*e*) Secure bevel gear (36) to shaft (38), using a setscrew. Slide the free end of shaft (38) through bearing (37) through washers (39), (40), (41), and (42), through ring (44) and bearing (47).

(*f*) Install bevel gear (46) on shaft (38) and secure with a setscrew.

(*g*) Place bearing (34) and gear cluster (33) in position on plate (70). Insert shaft (31) with retainer (30) and bearing (29) through gear cluster (33), bearing (34), and plate (70). Secure gear cluster (33) with two setscrews (32).

(*h*) Assemble and install the clutch assembly as follows:

1. Place bearing (21), shim (22) (if required), and clutch gear (23) on shaft (31).

2. Place positive clutch (25) on shaft (20) and secure temporarily with a 2–56 x 1/2 lg, pan hd, mach., sst, screw.

3. Place a modified spacer ring (26) which has a one-eighth inch wide slot cut from end to end, over positive clutch (25). The slot will be used to making final adjustment of positive clutch (25).

4. Place spur gear (27) and bearing (28) on shaft (20) and install the assembled clutch assembly into the appropriate hole in plate (70).

5. Install ball (19) and spring (18) through the hole over the PWR OUT PEAK control shaft and secure with screw (17).

(*i*) Place threaded ring (16) with setscrew (15) on the right hand cavity PWR OUT PEAK control shaft.

(*j*) Grease the threads of lead screw (14); screw item (14) into threaded ring (16).

(*k*) Install bearing (13), adjustment hub (11), clamp (10), spur gear (9) and bearing (8) on the shaft of leadscrew (14).

(*l*) Assemble and install the output stop washer assembly as follows:

1. Place ring (4), washers (5) and (6) and bearing (7), on the long end of shaft (2). Place bearing (1) on the other end of shaft (2).

2. Install the assembled stop washer assembly in the appropriate hole in plate (70).

(*m*) Install cover plate (3) (fig. 5–1) and secure with five screws (1) and washers (2).

(*n*) Tighten setscrew (56) (fig. 5–2) on the threaded ring (57). Position the threaded portion of leadscrew (55) approximately one thirty second inch from the rear of plate (70), and tighten clamp (52) with the screw provided.

(o) Check for backlash between bevel gears (51) and (46). Set backlash to 0.001/0.003 in. using shims (53) as required.

(*p*) Position the adjustment hub (50) to within 0.002 in. of bearing (48) and secure with two setscrews (49).

(*q*) Adjust the stop washers and drive mechanism as follows:

1. Set the keyed ring lock (44) so that the six keyed washers (42) are free to rotate. Secure (44) with setscrew (43).

2. Adjust bevel gear (36) and cluster gear (33) for 0.001/0.002 in. backlash by po

sitioning cluster gear (33) and securing it with setscrew (32).

3. Set the keyed ring lock (4) so that the six keyed washers (5) are free to rotate. Secure (4) with setscrew (3).

(*r*) Adjust and secure the right hand leadscrew (14) as follows:

1. Tighten setscrew (15) on threaded ring (16).

2. Position the threaded portion of leadscrew (14) approximately one thirty-second inch from the rear of plate (70).

3. Position adjustment hub (11) so that it touches bearing (13). Secure adjustment hub (11) with setscrew (12).

4. Position spur gear (9) approximately 0.002 in. from bearing (8); secure spur gear (9) with clamp (10). Check for smooth operation and minimum end play of leadscrew (14).

(*s*) Adjust and secure positive clutch (25) as follows:

1. Push shaft (20) in so that ball (19) rests in the second ring from the end of shaft (20).

2. Loosen the setscrew in positive clutch (25); engage positive clutch (25) and clutch spur gear (27) and tighten the setscrew in item (25).

3. Pull shaft (20) out so that ball (19) rests in the first ring from the end of shaft (20). Check to see that positive clutch (25) engages clutch spur gear (23).

4. Check the play of items (23), (25), and (27) between bearings (21) and (28). If play is excessive, install shims (22) as required and check again for play.

5. Remove cover plate (3) (fig. 5–1).

6. Remove screw (17) (fig. 5–2), spring (18), and ball (19).

7. Pull out and remove clutch assembly items (20) thru (28).

8. Remove items (28), (27), and (26) from shaft (20).

9. Drill a 0.0619 in. ± 0.0004 in. diameter hole through positive clutch (25) and shaft (20), and pin with dowel pin (24).

10. Install modified spacer ring (26), spur gear (27), and bearing (28) on shaft (20).

11. Install clutch assembly into the appropriate hole in plate (70).

12. Install ball (19) and spring (18) and secure with screw (17).

13. Install cover plate (3) (fig. 5–1) and secure with the five screws (1) and washers (2).

14. Check the PWR OUT PEAK mechanism for smooth operation, with shaft (20) (fig. 5–2) in the pushed-in and pulled-out positions.

(*t*) Secure the driver tube stop washer mechanism as follows (fig. 5–2):

1. Remove cover plate (3) (fig. 5–1).

2. Drill 0.046 in. +0.007, –0.000 in. diameter holes in each of bevel gears (36) and (46) and shaft (38). Pin the gears to the shaft with corresponding dowel pins (35) and (45).

3. Install cover plate (3) (fig. 5–1) and secure with the five screws (1) and washers (2).

(3) *Installation of channel frequency indicator 6AR1A1DS1 drive mechanism (fig. 5–2).*

(*a*) Press fit the two oilite bearings (62) into the mounting holes on plate (70).

(*b*) Insert the round end of shaft (63) through left hand bearing (62), through bevel gear (61), and right hand bearing (62).

(*c*) Install channel frequency indicator (69) with flexible shaft (59) attached and secure with four mounting screws (67) and washers (68).

(*d*) Push shaft (63) into flexible shaft (59) as far as possible. Pull shaft (63) back approximately one-sixteenth inch and secure bevel gear (61) with a setscrew.

(*e*) Drill a 0.046 in. +0.0007, –0.0000 in. diameter hole through bevel gear (61) and shaft (63) and pin the gear with dowel pin (60). Remove the setscrew.

(4) *Installation of frequency multiplier 6A2 tuning drive mechanism.*

(*a*) Press fit sleeve bearing (75) into plate (70).

(*b*) Position spur gear (71) and slide shaft (66) through spur gear (71), through sleeve bearing (75), and into bevel gear (65). Secure bevel gear (65) with a setscrew.

(*c*) Position spur gear (71) approximately 0.002 in. from sleeve bearing (75) and secure with a setscrew.

(*d*) Drill a 0.046 in. +0.0007, –0.0000 in. diameter hole through bevel gear (65) and shaft (66) and pin the gear with dowel pin (64). Remove the setscrew.

(*e*) Drill a 0.0619 in. ±0.0004 in. diameter hole through spur gear (71) and shaft (66) and pin the spur gear with dowel pin (72). Remove the setscrew.

(*f*) Install flexible shaft (73) on shaft (66) and secure with a setscrew.

(*g*) Install frequency multiplier assembly 6A2 as described in paragraph 3–53.

(*h*) Loosen the setscrew and position flexible shaft (73) equally between frequency

multiplier 6A2 tuning shaft and shaft (66). Tighten the setscrew.

(*i*) Drill a 0.0619 in. ±0.0004 diameter hole through flexible shaft (73) and shaft (66) and pin with dowel pin (74). Remove the setscrew.

(5) *Final reassembly of transmitter rf head.*

(*a*) Temporarily install the XMTR TUNE control knob and perform realignment tests as described in paragraph 5–5.

(*b*) Remove the XMTR TUNE control knob and install control panel 6 MP1 as described in paragraph 4–102.

(*c*) Replace amplifier-frequency multiplier cover 6MP2 and secure it in place with the five screws provided.

d. Parts List for Figure 5–1.

Item	Reference Symbol	Description
1	6AR1A1H5	Screw, 6-32 x 5/16 lg pan. hd. mach. sst.
2	6AR1A1H3	Washer, spring tension
3	6AR1A MP59	Cover plate, amplifier
4	6AR1A1H2	Screw, 6-32 x 3/8 lg pan. hd. mach. sst.
5	6AR1A1H6	Washer, spring tension
6	6AR1A1MP52	Guard, mechanical drive
7	6AR1A1MP21	Screw, shoulder
8	6AR1A1A17	Sprocket wheel assembly
9	6AR1A1MP118	Chain, roller
10	6AR1A1MP100	Bearing, ball, annular
11	6AR1A1H1	Screw, set 4-40 x 1/8 hex. socket hd., cup point, sst.
12	6AR1A1A21	Gear, spur-stop
13	6AR1A1MP16	Shaft, shouldered
14	6AR1A1MP101	Bearing, ball, annular
15	6AR1A1H1	Screw, set 4-40 x 1/8 hex. socket hd., cup point, sst.
16	6AR1A1MP90	Sprocket wheel
17	6AR1A1MP119	Key, Woodruff
18	6AR1A1A2MP2	Shaft, shouldered
19	6AR1A1H1	Screw, set 4-40 x 1/8 hex. socket hd., cup point, sst.
20	6AR1A1MP91	Sprocket wheel
21	6AR1A1MP120	Key, Woodruff
22	6AR1A1A3MP3	Shaft, shouldered
23	6AR1A1H1	Screw, set 4-40 x 1/8 hex. socket hd., cup point sst.
24	6AR1A1MP92	Sprocket wheel
25	6AR1ApMP121	Key, Woodruff
26	6AR1A1MP20	Lead screw
27	6AR1A1H1	Screw, set 4-40 x 1/8 hex. socket hd., cup point, sst.
28	6AR1A1A20	Gear cluster, spur, sprocket
29	6AR1A1MP122	Key, Woodruff
30	6AR1A1MP18	Lead screw
31	6AR1A1H1	Screw, set 4-40 x 1/8 hex. socket hd., cup point, sst.
32	6AR1A1MP93	Sprocket wheel
33	6AR1A1MP123	Key, Woodruff
34	6AR1A1MP19	Lead screw

e. Parts List for Figure 5–2.

Item	Reference Symbol	Description
1	6AR1A1MP102	Bearing, ball, annular
2	6AR1A1MP84	Gear shaft, spur
3	6AR1A1H1	Screw, set 2-56 x 1/8 hex. socket hd., cup point sst.
4	6AR1A1MP30	Ring, lock, keyed
5	6AR1A1MP39 to 44	Washer, key
6	6AR1A1MP66	Washer, key
7	6AR1A1MP103	Bearing, ball, annular
8	6AR1A1MP110	Bearing, ball, annular
9	6AR1A1MP77	Spur gear, split hub
10	6AR1A1A18	Clamp
11	6AR1A1MP74	Adjustment hub
12	6AR1A1H1	Screw, set 2-56 x 1/8 hex. socket hd., cup point sst.

Item	Reference Symbol	Description
13	6AR1A1MP111	Bearing, ball, annular
14	6AR1A1MP13	Lead screw
15	6AR1A1H1	Screw, set 4-40 x 1/4 lg. hex. socket hd., cup point sst.
16	6AR1A1MP27	Ring, threaded
17	6A3H2	Screw, set 8-32 x 3/8 lg. Nylok type M74FS832-6C
18	6AR1A1MP67	Spring, helical compression
19	6AR1A1MP117	Ball, Pic Design Corp., AL-3, 0.1562 dia., nylon.
20	6AR1A1MP15	Shaft, shouldered
21	6AR1A1MP108	Bearing, ball, annular
22	6A3H3	Shim
23	6AR1A1MP87	Gear, spur, clutch
24	6AR1A1H1	Pin, dowel, 0.0624/0.627 dia., 5/16 lg sst.
25	6AR1A1MP53	Clutch, positive
26	6AR1A1MP22	Spacer, ring
27	6AR1A1MP88	Gear, spur, clutch
28	6AR1A1MP109	Bearing, ball, annular
29	6AR1A1MP106	Bearing, ball, annular
30	6AR1A1H1	Waldes Truarc retaining ring 5100-12.
31	6AR1A1MP11	Shaft, straight
32	6AR1A1H2	Screw, set 2-56 x 1/16 hex. socket hd., cup point sst.
33	6AR1A1MP89	Gear cluster, bevel, spur
34	6AR1A1MP107	Bearing, ball, annular
35	6AR1A1H1	Pin, dowel, 0.0468/0.0470 dia., x 1/4 lg, sst.
36	6AR1A1MP80	Gear, bevel, pinion
37	6AR1A1MP104	Bearing, ball, annular
38	6AR1A1MP10	Shaft, straight, fine tuning
39	6AR1A1H1	Washer, spring tension
40	6AR1A1H1	Washer, flat.
41	6AR1A1MP65	Washer, key
42	6AR1A1MP33 to 38	Washer, key
43	6AR1A1H1	Screw, set 2-56 x 1/8 hex. socket hd., cup point sst.
44	6AR1A1MP29	Ring, lock, keyed
45	6AR1A1H1	Pin, dowel, 0.0468/0.0470 dia., x 1/4 lg sst.
46	6AR1A1MP76	Gear, bevel, pinion
47	6AR1A1MP105	Bearing, ball, annular
48	6AR1A1MP114	Bearing, ball, annular
49	6AR1A1H1	Screw, set 2-56 x 1/8 hex. socket hd., cup point sst.
50	6AR1A1MP75	Adjustment hub
51	6AR1A1MP81	Gear, bevel, split hub
52	6AR1A1MP19	Clamp
53	6A3H3	Shim
54	6AR1A1MP115	Bearing, ball, annular
55	6AR1A1MP14	Lead screw
56	6AR1A1H1	Screw, set 4-40 x 1/4 lg. hex. socket hd., cup point sst.
57	6AR1A1MP28	Ring, threaded
58	6AR1A1H1	Screw, set 2-56 x 1/8 hex. socket hd., cup point sst.
59	6AR1A1MP17	Shaft, drive, flexible
60	6AR1A1H1	Pin, dowel, 0.0468/0.0470 dia., x 1/4 lg., sst.
61	6AR1A1MP78	Gear, bevel, pinion
62	6AR1A1MP94 & 95	Bearing, Oilite
63	6AR1A1MP9	Shaft, shouldered, indicator drive
64	6AR1A1H1	Pin, dowel, 0.0468/0.0470 dia., x 1/4 lg. sst.
65	6AR1A1MP79	Gear, bevel, pinion
66	6AR1A1MP8	Shaft, shouldered
67	6AR1A1DS1H4	Screw, machine
68	6AR1A1DS1H4	Washer, spring tension
69	6AR1A1DS1	Indicator, channel
70	6AR1A1MP60	Plate, electrical, mechanical, center machine assembly.
71	6AR1A1MP86	Gear, spur
72	6AR1A1H1	Pin, dowel, 0.0624/0.657 dia., 5/16 lg, sst.
73	6AR1A1MP12	Shaft, flexible
74	6AR1A1H1	Pin, dowel, 0.0624/0.627 dia., 5/16 lg. sst.

5-5. Alignment of Radio Frequency Amplifier 6AR1

a. Test Equipment and Material Required..

Equipment	Common Name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V)	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM(V)	Accessory kit
Wattmeter AN/URM-98	Power meter
Counter, Electronic Digital Readout AN/USM-207	Counter
Wattmeter AN/URM-120	Wattmeter
Multimeter TS-352B/U	Multimeter
Drive Generator Sierra 470A-500	Power signal source

b. Test Procedure.

(1) *Test setup.*

(*a*) Disconnect cable 6AR1W1 from the J1 connector of 6AR1A1 and the J3 connector of 6AR1A2A4.

(*b*) Connect the test equipment as shown in figure 4-69A, but do not connect the power signal source at this time.

(*c*) Connect the flexible cooling air extension pipe to the test facility and place the nozzle on the stand behind the unit under test.

(*d*) Set the test facility switches as follows:

Switch	Position	Normal indication
S1	ON	
S16	OUTPUT NORMAL	
S13	ON	LOW PWR lamp should light
S20	+12v	Meter M1 should indicate in green band
S20	+28v	Meter M1 should indicate in green band
S20	+600v	Meter M1 should indicate in green band

(2) *Filament voltage, tube current and emission check.*

(*a*) Set the test facility switches S20 to S12 and S12 to REF, and note the indication on meter M1.

(*b*) Connect unit under test TP1 (+) and TP2 (–) to test facility connectors J18 (+) and J15 (–).

(*c*) Set switch S12 to FIL V and adjust unit under test R4 FIL to the same indication noted in (*a*) above.

(*d*) Connect unit under test TP4 (+) and TP3 (–) to test facility connectors J18 (+) and J15 (–).

(*e*) Adjust unit under test R3 FIL to the same indication noted in (*a*) above.

(*f*) Set switch S12 to DRIVER CUR and adjust R1 BIAS DRIVER for 50 percent of full scale on meter M1.

(*g*) Set switch S12 to OUTPUT CUR and adjust R2 BIAS OUTPUT for 50 percent of full scale on meter M1.

(*h*) Set switch S12 to EMISSION and S15 to OUTPUT. Allow tube warm-up time of at least 60 seconds.

(*i*) Press switch S14 EMISSION for 15 seconds and observe that meter M1 indicates within the green band during the test.

NOTE

If the meter M1 indication slowly reduces out of the green band, replace output tube V1 and repeat (*a*), (*b*), (*c*), (*f*), (*g*), and (*h*) above.

(*j*) Switch S15 to DRIVER, then press switch S14 EMISSION for 15 seconds and observe that meter M1 indicates in the green band during the test.

NOTE

If the meter M1 indication slowly reduces out of the green band, replace driver tube V2 and repeat (*d*), (*e*), (*g*), and (*j*) above.

(3) *Output amplifier adjustment.*

CAUTION

Do not allow the power signal source output to exceed 6 watts as damage may result to the unit under test.

(*a*) Connect the power signal source to the bidirectional coupler.

(*b*) Set the unit under test XMTR TUNE control to channel 320.

(*c*) Tune the power signal source frequency to 360 MHz ± 0.1 percent. Use the counter to check the frequency (fig. 4-69A).

(*d*) Adjust the output level of the power signal source to obtain a 4-watt indication on the power meter (fig. 4-69B).

(*e*)) Tune the XMTR TUNE control for a peak indication on the wattmeter.

(*f*) Pull out the unit under test PWR OUT PEAK control and adjust for maximum indication on the wattmeter.

(*g*) Repeat (*e*) and (*f*) above until maximum power indication is 35 watts or greater.

NOTE

If the power peaks near the end of the PWR OUT PEAK tuning range (in the PULL FOR OUTPUT position) adjust the stop washer assembly stop position located on the right-hand side of the gear box (items (3) and (4), fig. 5–2). Set for the center of the range.

(*h*) Channel number 320 should not be displaced more than one-fourth inch above or below the center notch on the unit under test XMTR TUNE window.

NOTE

If channel number is more than one-fourth inch above or below the XMTR TUNE window centerline, adjust the tape display (fig. 4–70) as follows: Hold the display unit firmly and remove the four red-circled mounting screws. Remove the tape display by carefully sliding the unit sideways without rotating the flexible shaft. Adjust the tape to indicate 320 at the calibration mark (notch) at the side of the tape display by turning the flexible shaft. Hold the tape and carefully slide the flexible shaft over the hexagonal shaft. Secure the tape display with the four screws provided. Note the exact position of the number 320 with reference to the calibration mark.

(4) *Input matching and tuning limit mechanism.*

(*a*) Set unit under test XMTR TUNE control to channel 40.

(*b*) Set the tuning limit mechanism (sprockets (28) and (12), fig. 5–1) to stop in the first possible position below channel 40.

NOTE

Item (12) the spur gear stop (fig. 5–1) is released by unscrewing the setscrews and positioned so that the uins meet. If the stop mechanism binds on the first clockwise rotation of the gears, reposition the spur stop one tooth clockwise.

(*c*) After completing (*b*) above, return the XMTR TUNE control to this stop position.

(*d*) Remove the drive chain idler assembly (items (6), (7), and (8), fig. 5–1) to slacken the chain.

NOTE

Do not release the chain from the three anode sprockets (items (24), (28), and (32), fig. 5–1). Pull the chain free from the two center cathode sprockets (items (16) and (20), fig. 5–1).

(*e*) Rotate the right hand released cathode sprockets clockwise until a stop position is reached. Back off the sprocket slightly (approx. one-eighth of a turn) from this stop.

(*f*) Repeat (*e*) above for the left-hand cathode sprocket.

(*g*) Replace the chain over the cathode sprocket, install the drive chain idler assembly, and secure in place.

(*h*) Set the XMTR TUNE control to channel 410. Check to see that the tuning limit mechanism stop is in a position above channel 410.

(*i*) Calibrate the power signal source to 405 MHz ± 0.1 percent as in (3)(*b*) and (*c*) above.

(*j*) Tune for optimum power output as in (3)(*d*) through (*f*) above. The power output should be 30 watts or greater.

NOTE

It should not be necessary to adjust the PWR OUT PEAK stop washer assembly.

(*k*) Connect the power meter to the reflected power port of the bidirectional coupler as shown in figure 4–69C. The reflected power indicated on the power meter should be less than 800 mw.

(*l*) Set the test facility switch S13 to OFF.

(*m*) Reconnect cable 6ARW1 to connector J1 of 6AR1A1.

(5) *Driver amplifier adjustment.*

(*a*) Connect the test equipment as shown in figure 4–71).

(*b*) Set test facility switch S16 to DRIVER TEMPORARY.

(*c*) Check and reset, if required, the power signal source to 360 MHz ± 0.1 percent at 4 watts (fig. 4–71A and B).

(*d*) Set the unit under test XMTR TUNE control to channel 320 at the same position noted in (3)(*h*).

(*e*) Set test facility switch S13 to ON.

(*f*) Push in the PWR OUT PEAK control on the unit under test and adjust for maximum indication on the wattmeter.

NOTE

If the power peaks near the end of the PWR OUT PEAK tuning range (in the PUSH FOR DRIVER position) adjust the stop washer assembly stop position located on the left hand side of the gear box (items (43) and (44) fig. 5–2). Set for the center of the range.

CAUTION

Maintain equal rotation of the adjustable driver lead screw nuts, otherwise the driver plate plunger will be misaligned.

(*g*) Loosen the setscrews in the two driver lead screw nuts (fig. 4–70) and tune the driver amplifier by adjusting the lead screw nuts and the PWR OUT PEAK control for maximum power indication on the wattmeter. The wattmeter indication should be 35 watts or greater.

(*h*) Tighten the setscrews on the driver lead screw nuts and seal with liquid sealant.

(6) *Driver input matching*

(*a*) Set the XMTR TUNE control to channel 410.

(*b*) Tune the power signal source to 405 MHz ± 0.1 percent and set the output level for 4 watts. (fig. 4–71A and B).

(*c*) Push in and adjust the PWR OUT PAEK control, and the XMTR TUNE control if necessary, for a maximum indication on the power meter. The output level should be greater than 30 watts.

(*d*) Connect the power meter to the reflected power port of the bidirectional coupler as shown in figure 4–71C. The indication should be less than 800 mw.

(*e*) Reduce the power signal source output to zero. Switch test facility switch S13 to OFF.

(7) *Tuning and power output check.*

(*a*) Modify the test set-up shown in fig. 4–71 by using cable 6AR1W1 to reconnect connector J1 of 6AR1A1 to connector J3 of 6AR1A–2A4 and by connecting the P1(6AR1A1J2) lead from 6AR1A2FL1 to connector J2 of 6AR1A1. This setup is to check the driver and output tubes as a unit.

CAUTION

Do not exceed the specified drive level from the power signal source; damage to the unit under test may result.

(*b*) Calibrate the power signal source to 220 MHz ± 0.1 percent at 200 mw as in (3)(*b*) and (*c*) above.

(*c*) Set test facility switch S12 to DRIVER, S16 to OUTPUT NORMAL, and S13 to ON.

(*d*) Set unit under test XMTR TUNE control to channel 40, so that the number is one-half inch below the center notch on the tape display indicator.

(*e*) Push in the PWR OUT PEAK control on the unit under test and adjust for maximum indication on test facility meter M1.

(*f*) Pull out the PWR OUT PEAK control on the unit under test and adjust for maximum indication on the test facility meter M1 and the wattmeter.

(*g*) Repeat (*d*), (*e*), and (*f*) above, from one-half inch below the center notch on the tape indicator to one-half inch above the notch. The maximum power output should occur within the tape indication limits specified and the level, measured on the wattmeter, should be at least 35 watts for channel 40.

(*h*) Repeat (*d*) through (*g*) above for remaining channels listed below.

Channel	Frequency (MHz)	Power output (watts)	Specified drive power (mw)
100	250	32	200
200	300	40	200
300	350	35	200
410	405	30	300

(*i*) Set test facility switch S13 to OFF.

NOTE

Check frequency multiplier assembly 6A2 tracking with radio frequency amplifier 6AR1 to complete alignment of unit as described in paragraph 4–29 *b* (3).

5–6. Assembly and Disassembly of Control-Indicator 2A2 or 6A3

a. General.

(1) This paragraph describes the disassembly and assembly of control-indicator 2A2 and 6A3 which are used for channel selection in the receiver and transmitter rf heads.

(2) On the control-indicator installed in the first production units, the microswitches and the decoder logic circuit are mounted either directly on the casting or on an additional brass plate which is screwed to the casting.

(3) The cam code is the same for both 2A2 and 6A3, but the 2A2 is set for 60 channels higher.

(4) Apply heat with a soldering iron to soften the Loctite from the setscrews before trying to remove them.

b. Tool Requirements.

Item	Tool
1	Screwdriver
2	Drift pin punch
3	0.003 in. feeler gauge
4	Channel selector test jig
5	2 Allen keys No. 050

Item	Tool
	and 035
6	Hammer
7	No. 52 Waldes Truarc retaining ring pliers
8	Open-end wrench, 1/2 in.
9	Torque wrench for 70 oz/in.

c. Disassembly Procedure (fig. 4–65).

(1) *General*

(*a*) Remove the four mounting screws hat secure the cover. Remove the cover.

(*b*) To insure that the counter wheels are roperly reassembled, note the following:

1. All switches except S12 are pressed at hannel 111 for 6A3 and channel 51 for 2A2.

2. Moving the tuning control shaft to hannel 112 (6A3) or 52 (2A2) will cause all our cam banks to operate. In this position only witch S12 is pressed.

3. The "hundreds" counter wheel has wo range limit stops: at 000 and 499. These are mall triangular metal pieces inserted in the ounter wheel teeth.

4. The Allen screw at the bottom of ach switch is for gap adjustment only.

(2) *Removal of microswitches and command ignal decoder 2A2A2 or 6A3A2.*

NOTE

The two assemblies should be removed together to avoid unsoldering.

(*a*) Loosen and remove the screws that se- ure 2A2A2 or 6A3A2 to the casting.

(*b*) Loosen and remove the two mounting crews holding the microswitch mounting plate nd the two screws that hold the cam follower older (next to S13).

(*c*) Loosen and remove the small screws etween microswitches S12–S11, S9–S8 and S6–5.

(*d*) Lift command signal decoder 2A2A2 r 6A3A2 and the microswitches off the cast- ng. Do not tilt the casting.

(*e*) Remove the 11 ball bearings from heir holes.

(3) *Removal of numerical counter wheels.*

NOTE

The counter wheels and drive gear are held in place by a retaining ring to the right of the "units" counter wheel.

(*a*) Use the Truarc pliers to open the re- aining ring; slide the ring toward the casting as ar as it will go, then release the ring.

(*b*) Slide the shaft away from the body of the unit.

(*c*) Open the retaining ring again and slip it off the end of the shaft.

(*d*) Hold the counter wheels and slide the shaft through the end bearing plate.

(*e*) Remove the washers and spacers before removing the shaft entirely.

(4) *Removal of cam banks Geneva mechanism.*

NOTE

The shaft is held in position by two setscrews located near the top right-hand cover of the casting.

(*a*) Melt the Loctite and remove the locking setscrew.

(*b*) Remove the second setscrew (inside the tapped hole).

(*c*) Slide out the shaft to release the three small Geneva mechanism gears.

(5) *Removal of cam bank and counter drive shaft.*

NOTE

The main drive gear, the first cam bank, and the counter drive gear are attached to the shaft by split pins.

(*a*) Use the pin punch to remove the pins from the main drive gear and the first cam bank.

(*b*) Place a support under the counter drive gear before removing the pin. The counter drive gear is mounted on a thinner shaft which may become bent or broken.

(*c*) Slide the shaft toward the right and remove the retaining ring at the end of the shaft.

(*d*) Slide the shaft out through the end bearing on the right side of the casting; the counter Geneva mechanism, the counter drive gear, the four cam blanks, and the spring retaining washer and shims are now released.

NOTE

The split pins and setscrews will probably be damaged in the process. Use new pins and setscrews when reassembling.

(*e*) Note the following characteristics.

1. Cam bank 1 (next to the main drive gear) is pinned.

2. Cam banks 2 and 3 are identical.

3. Cam bank 4 is the shortest of all.

(6) *Removal of tuning control drive shaft.*

(*a*) Remove the knob banking nut.

(*b*) Remove the retaining ring inside the casting and push the front bearing in along the shaft.

(*c*) Grip the tuning control shaft and pull the shaft forward to disengage the rear bearing.

(*d*) Tilt the tuning control upward, then slide the whole tuning shaft assembly through the bottom opening.

NOTE

The gear-nut assembly is a slipping clutch adjusted for 70 oz/in. ±10. Do not dismantle.

(7) *Removal of intermediate drive gear shaft.*

(*a*) Use the pin punch to remove the pins from the two gears on the intermediate drive shaft.

(*b*) Slide the intermediate drive shaft out through the end bearing plate.

d. Assembly of Control-Indicator 2A2 or 6A3.

(1) *General.* Assembly of control-indicator 2A2 or 6A3 is carried out in the following order:

(*a*) Main cam bank and counter drive assembly.

(*b*) Cam banks Geneva mechanism.

(*c*) Numerical counter wheel assembly.

(*d*) Intermediate drive shaft assembly.

(*e*) Tuning control shaft.

(*f*) Switches, command signal decoder unit, and associated mounting plates.

(2) *Main cam bank assembly.*

(*a*) Slide the main cam bank shaft through the right hand bearing.

(*b*) Fit the main drive gear over the shaft gear, teeth first.

(*c*) Fit the four cam banks in the following order:

1. Fit cam number 1 (with the pin hole) so that the cam follower positioning slots are toward the main drive gear.

2. Fit cams number 2, 3, and 4 (shortest of all) with gear teeth toward the main drive gear.

(*d*) Slide the shim and spring washer on the shaft and slide the shaft through the bearing in the separating wall.

(*e*) Fit the counter drive gear with the hub first.

(*f*) Slide on the three large size Geneva mechanism gears with the half teeth toward the end bearing plate.

(*g*) Slide the retaining ring and fit the end of the shaft through the bearing in the end bearing plate. Slide the retaining ring next to the end bearing plate.

(*h*) Pin cam number 1, the main drive gear, and the counter drive gear. Use split pins and support the counter drive gear when pinning.

NOTE

The counter drive gear can be pinned only when the original shaft and gear are being reassembled. In the event of either a new shaft or a new gear, leave the counter drive gear loose. It will be pinned after the counter wheels are installed.

(3) *Assembly of cam banks Geneva mechanism.*

(*a*) Set up cams number 1, 2, and 3 so that all cams are at their low points (in a position that does not depress any of switches S3 through S11. This occurs at only one position of the cam banks).

(*b*) Place cam bank number 4 so that its right side is in a position to depress S12 and its second and third cams are at a low point.

(*c*) With all four cam banks in the above position pass the Geneva mechanism shaft through the hole in the righthand side of the casting, in front of the cam-bank shaft.

(*d*) Feed the Geneva mechanism gears on to the shaft, with the half teeth on the left.

NOTE

Proceed with the next step carefully so as not to disturb the cam banks position.

(*e*) Fit the Geneva mechanism gears into the cam bank teeth one at a time, while sliding the shaft into the opposite hole in the casting wall. The shaft should be flush with the wall at either end.

(*f*) Insert a setscrew through the tapped hole in the front of the casting to hold the shaft in place.

(*g*) Check the cam bank settings as follows: Move the main drive gear ccw (looking toward the cam banks main drive gear) by three teeth. All cam banks should move simultaneously so that all cams on cam banks 1, 2, and 3 go to a high point while the first cam on cam bank 4 goes to a low point.

(*h*) If the condition in (*g*) above is not met, slacken the Geneva mechanism shaft and repeat (*a*) through (*g*) above.

(4) *Numerical counter wheel assembly.*

(*a*) Move the main drive gear three teeth cw (looking toward the cam banks). Cam banks 1, 2, and 3 should be now in their low point while the first cam on cam bank 4 should be at its highest point.

NOTE

This position corresponds to channel 112 for control-indicator 6A3 and channel 52 for control-indicator 2A2.

(*b*) Note the following:

1. The "units" counter wheel has an attached drive gear and will be the last gear to go on the shaft.

2. The "tens" counter wheel has figures 0 to 9 printed on it.

3. The "hundreds" counter wheel has figures 1 to 9 printed on it and has limit stops inserted between figures 4 and 5 and after 9.

4. The "thousands" counter wheel has figures 1 to 9 printed on it and is the first gear to be fitted onto the shaft.

(*c*) Pass the small end of the counter wheel shaft through the hole in the end bracket, then fit on the spacer and the washer.

(*d*) Slip on the "thousands" counter wheel with the blank space showing on the front and mesh the first Geneva mechanism gear with it.

NOTE

The following counter wheels are fitted for channel 112 (6A3). For the 2A2 unit fit the corresponding wheels to show blank, blank, 5 and 2.

(*e*) Slip the "hundreds" counter wheel with figure 1 showing in front and mesh with the second Geneva mechanism gear.

(*f*) Slip the "tens" counter wheel with figure 1 showing in front and mesh with the last Geneva mechanism gear.

(*g*) Pass the shaft through the units wheel with figure 2 showing in front. Slip the retaining ring on next.

(*h*) Push the small end of the shaft into the socket in the casting, then fit the retaining ring in the slot next to the counter wheel gear. The gear on the counter wheel should engage with the counter drive gear.

(*i*) Check the counter wheels. They should indicate channel 112 for 6A3 or 52 for 2A2.

NOTE

The following steps are applicable only when either a replacement counter drive gear or shaft has been used.

(*j*) Slide the counter drive gear until it engages with the gear on the "units" counter wheel. Tighten in position with a setscrew.

(*k*) Using the guide hole in the counter drive gear hub, drill a hole through the shaft and press a pin through. Support the counter drive gear when pinning. Remove the setscrew.

(5) *Intermediate drive shaft assembly.*

(*a*) Insert the intermediate drive shaft through the bearing in the right hand wall of the casting.

(*b*) Fit the aluminum spur gear, teeth first, and mesh it with the cam banks drive gear.

(*c*) Fit the helical gear on next with the teeth toward the small end of the shaft, and slide the shaft all the way home.

(*d*) Pin both gears.

NOTE

Do not pin the helical gear if either a replacement helical gear or a replacement shaft is used.

(*e*) Proceed with the next assembly, (6) (*a*) through (*d*) below, to position the helical gear on the shaft. Tighten in position with a setscrew.

(*f*) Remove the tuning control shaft assembly. Using the guide holes, drill through the hub and shaft and pin the helical gear. Remove the setscrew.

(6) *Tuning control shaft assembly.*

(*a*) Slide the gear-nut assembly over the tuning control shaft.

(*b*) Slide the front bearing on the tuning control shaft with the bearing collar toward the gear.

(*c*) Pass the knob end of the shaft through the front bearing opening.

(*d*) Lower the gear-nut end of the tuning control shaft until it meshes with its mating helical gear on the intermediate drive shaft assembly, then push the shaft into the rear bearing.

(*e*) Slide the front bearing forward on the shaft then push it into the front bearing opening.

(*f*) Push the "C" retaining clip into the slot behind the front bearing.

(*g*) Add a second setscrew to the first one holding the cam banks Geneva mechanism shaft in place ((3) above).

(*h*) Apply Loctite to all setscrews.

(7) *Reassembly of microswitches.*

(*a*) Place a ball bearing in each hole except for the first hole over cam bank number 1 and the last two holes over cam bank number 4.

(*b*) Fit the microswitches, attached to their anchor plate, and secure the plate temporarily with the mounting screw opposite S9.

(*c*) Loosely replace the three small screws (located between S12–S11, S9–S8 and S6–S5).

(*d*) Line up the switches, insuring that the small adjusting screw at the back of each microswitch is resting in its proper hole. Tighten the three small screws, replaced in (*c*) above.

(*e*) Place the cam follower ball (first hole position above cam bank number 1), the spring and holder so that it meshes with the cam follower section. Secure in position with the two screws provided. Place the grounding lug under the washer of the forward screw.

NOTE

Refer to paragraph 4–32 for details of replacing and adjusting microswitches.

(*f*) Place the other grounding lug under the screw next to S12 and tighten the screw.

Section III. REPAIR OF AMPLIFIER-CONVERTER AM–4316/GRC–103(V) (RECEIVER RF HEAD)

5–7. Replacement of Speed-Decreaser Gear Assembly 2A1MP1

a. Removal Procedure.

(1) Remove amplifier converter cover 2MP1 as described in TM 11–5820–540–12.

(2) Remove control panel 2A1MP2 (para 4–99).

(3) Remove speed decreaser gear assembly 2A1MP1 as follows:

(*a*) Loosen the setscrew securing clamp hub 2A1A1A1MP1MP24 (fig. 4–134).

(*b*) Move spur gear 2A1A1A1MP1MP18 toward the front of the chassis to disengage speed-decreaser gear assembly 2A1MP1.

(*c*) Remove the three red-circled mounting screws that secure 2A1MP1 to the chassis, and lift 2A1MP1.

b. Installation procedure.

NOTE

Unless otherwise specified the following installation procedure applies only to units removed but not replaced. See *c* below for replacement procedures.

(1) Install speed decreaser gear assembly 2A1MP1 as follows:

(*a*) Position the module and secure it to the chassis with the three mounting screws.

(*b*) Slide spur gear 2A1A1A1MP1MP18 (fig. 4–134) along the shaft until it engages with the gear on speed decreaser gear assembly 2A1MP1.

(*c*) Slide clamp hub 2A1A1A1MP1MP24 along the shaft until it is tight against the spur gear and tighten with the setscrews.

(*d*) Make certain there is about 0.001 to 0.002 in. play between the two gears when engaged.

CAUTION

Do not rotate the shaft.

(2) Reinstall the control panel 2A1MP2 (para 4–99).

(3) Proceed with the receiver signal–local oscillator tracking alignment as described in paragraph 4–56.

(4) Replace amplifier converter cover 2MP1 as described in TM 11–5820–540–12.

c. Replacement procedure.

NOTE

The following procedure applies only when replacing a defective speed decreaser gear assembly 2A1MP1.

(1) On the replacement unit, loosen the setscrew securing bevel gear 2A1MP1MP20 (fig. 5–3).

(2) Install the replacement 2A1MP1 as described in *b*(1)(*a*) through (*d*) above.

(3) Check for correct play between the gears as described in paragraph 5–7.

(4) Slightly tighten the setscrew on bevel gear 2A1MP1MP20, moving the gear in and out until a 0.001 to 0.002 in. play is achieved. Tighten the setscrew on 2A1MP1MP20.

(5) Replace the setscrew on 2A1MP1MP20 with a dowel pin as follows:

(*a*) Remove the speed decreaser gear assembly as described in *a* above.

(*b*) Leave the setscrew tight to insure no movement during next operation.

(*c*) Use the existing pilot hole in bevel gear 2A1MP1MP20, and drill a 0.0615 + 0.0008 –0.0000 in. diameter hole through gear hub and shaft.

(*d*) Pin the gear with a dowel pin 0.0624/0.0626 in. diameter, 7/16 inch long. Remove the setscrew.

(6) Reinstall speed decreaser gear assembly 2A1MP1 as described in *b* above.

5–8. Replacement of Bandpass Filter Assembly 2A1A2A3

a. Removal procedure.

(1) Remove amplifier converter cover 2MP1 as described in TM 11–5820–540–12.

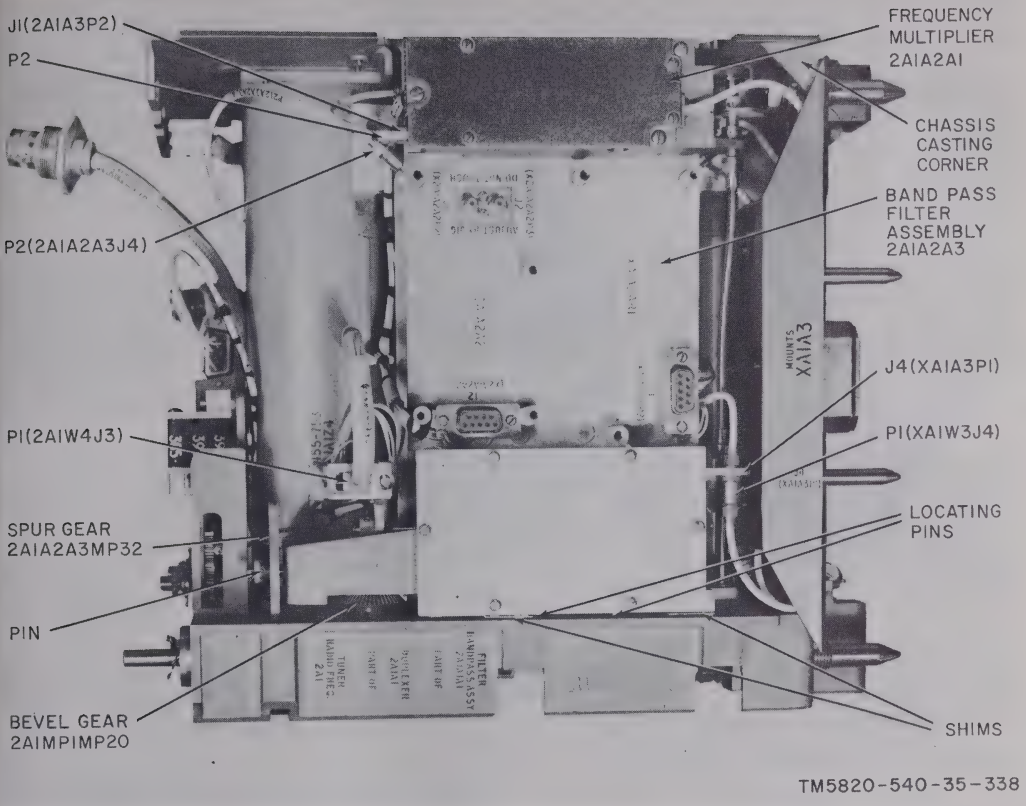


Figure 5-3. Receiver rf head (front panel removed) top view.

(2) Remove electronic switch 2A4 and electrical dummy load 2A3 (TM 11-5820-540-12, para 6-18).

(3) Remove the electronic frequency converter 2A1A2 as follows:

(*a*) Loosen the two screws and disconnect P1 (2A1W4J3) connector (fig. 5-3).

(*b*) Disconnect cable P2 from connector J1 (2A1A3P2).

(*c*) Disconnect cable P2(2A1A2A3J4) from connector J4 of bandpass filter assembly 2A1A2A3.

(*d*) Disconnect cable P1(XA1W3J4) from bulkhead connector J4 (XA1A3P1).

(*e*) Remove one set of four red-circled mounting screws (fig. 4-134) that secure the bandpass filter assembly 2A1A2A3 (part of 2A1A2) to the chassis.

(*f*) Remove a second set of four red-circled mounting screws (fig. 5-4) located on the left hand side of the chassis above Z1 and Z4 cavities.

(*g*) With the unit upright, move electronic frequency converter 2A1A2 toward the left side by about 3/8-inch to clear the locating pins (fig. 5-3). Tilt slightly upward until frequency multiplier 2A1A2A1 clears the chassis; and remove 2A1A2 from the chassis.

(4) Disassemble electronic frequency converter 2A1A2 as follows:

(*a*) Disconnect cable P2(2A1A2A3J3) from connector J3 of bandpass filter assembly 2A1A2A3.

(*b*) Loosen the Allen screws on the coupling between the bandpass filter 2A1A2A3 shaft and the flexible drive shaft.

(*c*) Loosen the three red-circled screws that secure 2A1A2A1 to 2A1A2A3. Lift 2A1A2-

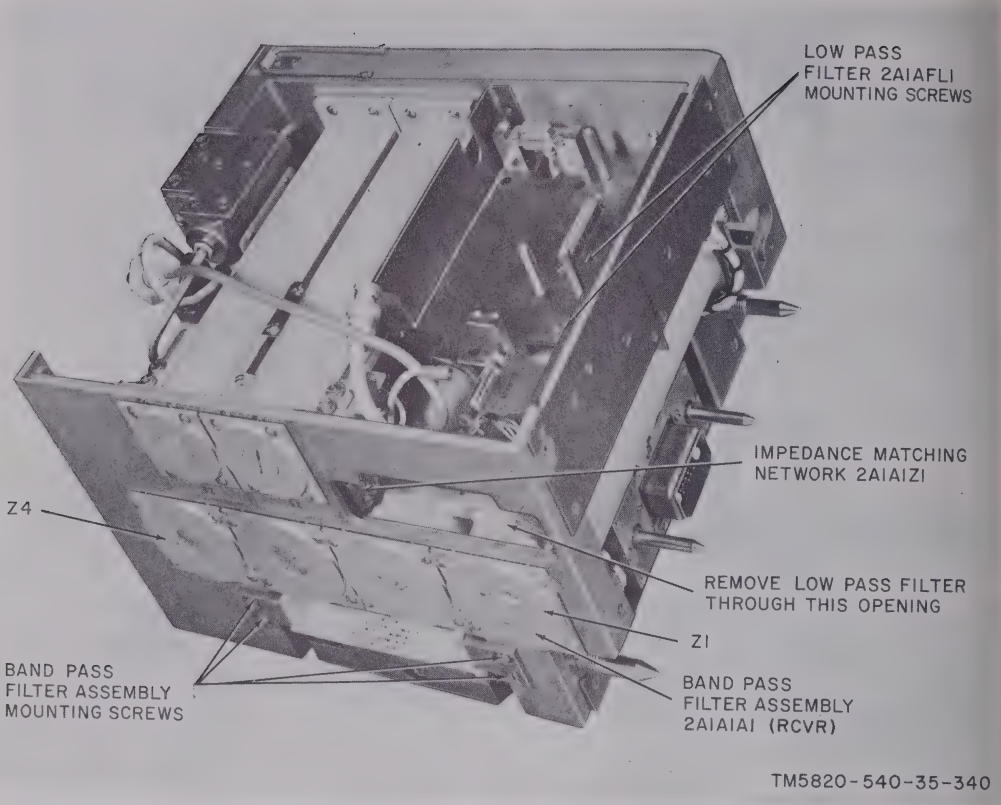


Figure 5-4. Receiver rf head (front panel removed), bottom and left side view.

A1 up from 2A1A2A3 to disengage its connector P1 and flexible drive shaft.

(*d*) Disconnect the intermediate frequency amplifier 2A1A2AR1 rf lead P1(XA1A2A2–J2) from J2 of frequency mixer stage 2A1A2A2.

(*e*) Loosen the four green-circled screws securing frequency mixer stage 2A1A2A2 to 2A1A2A3. Lift and remove 2A1A2A2 from 2A1A2A3 using the module extractor tool.

(*f*) Loosen the three green-circled mounting screws that secure intermediate frequency amplifier 2A1A2AR1 to bandpass filter assembly 2A1A2A3. Lift and remove 2A1A2AR1 from 2A1A2A3.

b. Replacement procedure.

(1) Install frequency multiplier 2A1A2A1 on the replacement bandpass filter assembly 2A1A2A3 as described in paragraph 5–12. Follow the procedure in paragraph 5–12 to track frequency multiplier 2A1A2A1 with bandpass filter assembly 2A1A2A3.

(2) Install frequency mixer stage 2A1A2A2 and intermediate frequency amplifier 2A1A2AR1 on bandpass filter assembly 2A1A2A3 and proceed with the remaining alignment procedures described in paragraph 5–12.

(3) Install electronic frequency converter 2A1A2 as follows:

(*a*) Rotate spur gear 2A1A2A3MP32 (fig. 5–3) until the pin on collar shaft 2A1A2–A3A9 is pointing upward.

(*b*) Place electronic frequency converter 281A2 in position, insuring that the two locating pins on the gear box frame enter the corresponding holes on bandpass filter assembly 2A1A2A3.

(*c*) Replace the four mounting screws on the gear assembly plate (fig. 4–134) but do not tighten at this time.

(*d*) Push frequency electronic converter A1A2 against the right side of the chassis, hold firmly, and check spur gear 2A1A2A3PM32 (fig. 5–3) for play. It should be between 0.001 and 0.002 in.

(*e*) Check bevel gear 2A1MP1MP20 for 0.001 to 0.002 in. play. If the amount of play is sufficient tighten the four mounting screws ((3) above).

NOTE

If the amount of play is insufficient, install shims between bandpass filter assembly 2A1A2A3 and the gear box frame.

(*f*) Replace the four mounting screws (fig. 5–4) on the left side of the chassis, and tighten the screws.

(*g*) Check again for backlash as in (*d*) and (*e*) above.

(*h*) Connect connector P1(2A1W4J3) to its mating connector and tighten the two screws (fig. 5–3).

(*i*) Reconnect cable P2 to connector J1 (2A1A3P2) on frequency multiplier 2A1A2A1.

(*j*) Reconnect P2 (2A1A2A3J4) to connector J4 on filter assembly 2A1A2A3.

(*k*) Reconnect P1(XA1W3P2) to bulkhead connector J4(XA1A3P1).

(4) Proceed with the receive signal-local oscillator tracking alignment as described in paragraph 4–56.

(5) Replace electronic switch 2A4 and electrical dummy load 2A3. (TM 11–5820–540–12 para 6–18).

(6) Replace amplifier converter cover 2MP1 as described in TM 11–5820–540–12.

5–9. Removal and Replacement of Duplexer 2A1A1

a. Disassembly procedure.

(1) Remove amplifier-converter cover 2MP1 as described in TM 11–5820–540–12.

(2) Remove control-indicator 2A2 (para 3–58).

(3) Remove radio frequency amplifier 2A1AR1 (para 3–59).

(4) Remove power supply 2PS1 (para 3–58).

(5) Remove electronic switch 2A4 and electrical dummy load 2A3 (para. 3–58).

(6) Remove electronic frequency converter 2A1A2 (para 5–8*a*).

(7) Remove control panel 2A1MP2 (para. 4–99).

(8) Remove channel frequency indicator 2A1A1A1DS2 and channel frequency indicator 2A1A1A1DS1 (para 4–103).

(9) Remove speed-decreaser gear assembly 2A1MP1 (fig 4–134) as follows:

(*a*) Loosen the setscrew that secures the clamp hub 2A1A1A1MP1MP24.

(*b*) Move spur gear 2A1A1A1MP1MP18 to the left to disengage the speed decreaser gear assembly.

(*c*) Remove the three red-circled mounting screws that secure the 2A1MP1 to the chassis, and lift 2A1MP1.

(10) Remove power monitor 2A1A5 (para 3–60).

(11) Remove low pass filter 2A1A1FL1 (para 3–62).

(12) Remove impedance matching network 2A1A1Z1 (para 4–98) if required.

CAUTIONS

1. Do not disassemble the unit beyond this stage. If side brackets are removed the cavity mounting will be weakened, drastically changing the characteristics of the duplexer filters.

2. Do not remove or slacken any of the bevel gears on the gear assemblies. Serious mechanical and electrical misalignment will result.

b. Reassembly procedure.

NOTE

The replacement duplexer will contain the transmitter and receiver bandpass filters mounted on the gear assembly plate, less low pass filter 2A1A1FL1, and with or without impedance matching network 2A1A1Z1.

(1) Install impedance matching network 2A1A1Z1 (para 4–98).

(2) Install low pass filter 2A1A1FL1 (para. 3–62).

(3) Install power monitor 2A1A5 (para. 3–60).

(4) Install speed decreaser gear assembly 2A1MP1 (fig. 4–134) as follows:

(*a*) Position the module and secure it to the chassis with the three mounting screws.

(*b*) Slide spur gear 2A1A1A1MP1MP18 (fig. 4–134) along the shaft until it engages with the gear in the speed decreaser gear assembly 2A1MP1.

(*c*) Slide clamp hub 2A1A1A1MP1MP24 along the shaft until it is tight against the spur gear and tighten with the setscrew.

(*d*) Make certain that there is about .001 to .002 in. play between the two gears when engaged.

CAUTION

Do not rotate the shaft.

(5) Install channel frequency indicator 2A1A1A1DS1 and channel frequency indicator 2A1A1A1DS2 (para. 4–103).

(6) Install electronic frequency converter 2A1A2 (para 5–8*b*) and check for backlash.

NOTE

If backlash is insufficient, speed decreaser gear assembly 2A1MP1 may be misaligned. Replace 2A1MP1.

(7) Engage connector P1 (2A1W4J3) with its mating connector and tighten the two screws (fig. 5–3).

(8) Reconnect connector P2 to connector J1 (2A1A3P2) on frequency multiplier 2A1A2A1.

(9) Reconnect P2(2A1A2A3J4) to connector J4 on bandpass filter assembly 2A1A2A3.

(10) Reconnect P1(XA1W3P4) to bulkhead connector (XA1A3P1).

(11) Adjust the tracking between bandpass filter assembly 2A1A1A1 and bandpass filter assembly 2A1A2A3 (para 4–56).

(12) Reinstall control panel 2A1MP2 (para 4–99).

(13) Reinstall electronic switch 2A4 and electrical dummy load 2A3 (para 3–58).

(14) Reinstall power supply 2PS1 (para 3–58).

(15) Reinstall radio frequency amplifier 2A1AR1 (para 3–59).

(16) Reinstall control-indicator 2A2 (para 3–58).

(17) Reinstall amplifier converter cover 2MP1 as described in TM 11–5820–540–12.

5–10. Disassembly and Reassembly Procedures for Indicator Channel Alignment Gear and Shaft Coupling

NOTE

When the gear is replaced, replace the shaft also.

a. Remove control panel 2A1MP2 as described in paragraph 4–99.

b. Remove 2A1A1A1DS1 and 2A1A1A1DS2 as described in paragraph 4–103.

c. Locate the bevel gear shaft and collar which make up the coupling (fig. 4–197).

d. Remove the dowel pin on the bevel gear.

e. Remove the retaining ring washer from the end of the shaft.

f. Slide the shaft with collar attached toward the left side of the head. The gear will be pushed off the end of the shaft.

g. Remove the collar from the shaft.

h. Insert the grooved end of the new shaft through the bearing on the left side of the head.

i. Slide the replacement gear over the grooved end of the shaft and insert the shaft through the bearing on the right side of the head.

j. Replace the retaining ring washer removed in *e* above.

k. Place the collar over the plain end of the shaft.

m. Tighten the collar so that there is no play in the shaft.

n. Mesh the two gears so that there is no backlash, then hold the replacement gear in position using two setscrews.

o. Select the correct size drill for the dowel pin to be used. Drill through the hole in the gear and continue half way through the shaft.

p. Rotate the gear and shaft 180 degrees.

q. Drill through the other hole in the gear and continue completely through the shaft.

r. Pin the gear and remove the setscrews.

s. Adjust the position of the collar on the shaft so that there is no backlash or binding between the bevel gears.

5–11. Alignment of Duplexer 2A1A1

Duplexer 2A1A1 is a subassembly of radio frequency tuner 2A1, and is aligned, together with the other subassemblies of 2A1, in chapter 4.

a. Align impedance matching network 2A1A1–Z1 with bandpass filter assembly 2A1A1 for best vswr as described in paragraph 4–57 *b*(5) (*b*). Slightly adjust C2(2A1A1Z1) for minimum vswr.

b. Align the transmitter channel tape with the transmitter section of the duplexer as described in paragraph 4–103*b*.

c. Align the receiver channel tape with the receiver section of the duplexer as described in paragraph 4–103*c*.

d. Align electronic frequency converter 2A1A2 with the receive filter of 2A1A1 as described in paragraph 4–56*b*(3).

5–12. Alignment of Electronic Frequency Converter 2A1A2

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility, Receiver TS-2867(V)1/GRM(V)	Receiver test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/GRM-95(V)	Accessory kit

Equipment	Common Name
Generator, Sweep Signal AN/USM-203	Sweep generator
Oscilloscope AN/USM-140	Oscilloscope
Wattmeter AN/URM-98	Power meter
Generator, Thermal Noise SG-419/U	Noise generator

b. Test Procedure.

(1) *Initial setting.*

(*a*) Install frequency multiplier 2A1A2A1 and the flexible shaft to the replacement bandpass filter assembly 2A1A2A3 (fig. 5–5). Do not secure the flexible shaft to the bandpass filter assembly at this time.

(*b*) Set the bandpass filter tuning gear fully counterclockwise to the stop position.

(*c*) Set the frequency multiplier cam so that the H datum line engages the stud of the piston.

(*d*) Secure the flexible shaft to the bandpass filter assembly. Check the mechanical linkage for ease of movement and lack of any undesirable free play or backlash.

(2) *Frequency tracking.*

(*a*) Connect the equipment as shown in figure 5–6A.

(*b*) Set the test facility switches as follows:

Switch	Position
S1	ON
S5	S4
S4	ON
S6	DBLR

(*c*) Adjust the sweep generator for an output level of +12 dbm over the frequency range of 48 to 73 MHz.

(*d*) Set the sweep generator SWEEP control to 7.25 MHz.

(*e*) Turn the tuning gear (fig. 5–5) so that the M datum line on the frequency multiplier cam is in line with the stud in the piston.

(*f*) Slacken the setscrew in the flexible shaft at the end linking the bandpass filter tuning shaft.

(*g*) Without turning the flexible shaft, adjust the tuning gear slightly to obtain maximum amplitude of output response indicated on the oscilloscope. Carefully tighten the setscrews in the flexible shaft, insuring that the amplitude remains constant.

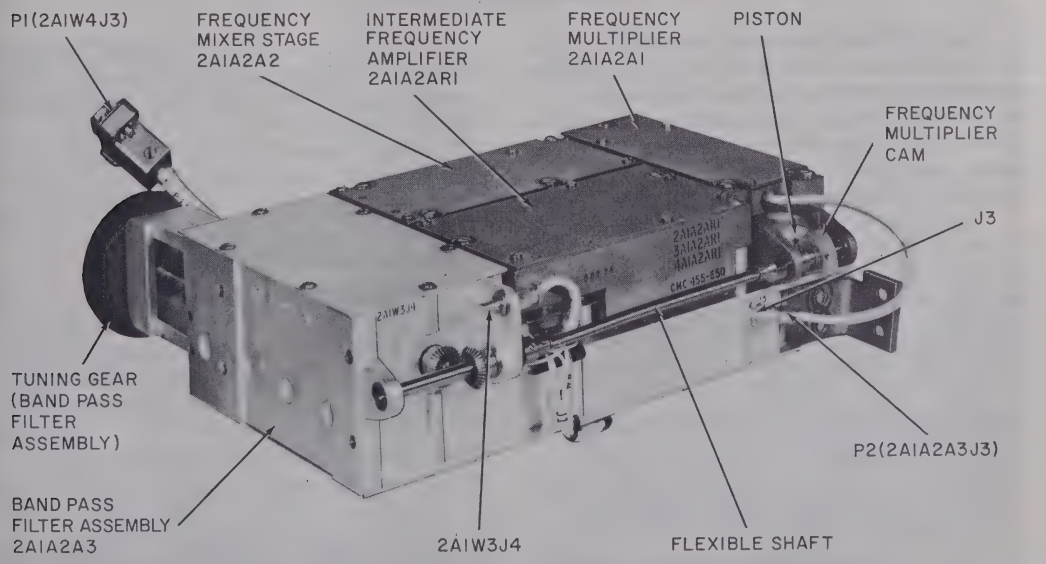


Figure 5-5. Electronic frequency converter 2A1A2 showing bandpass filter assembly and frequency multiplier linkage.

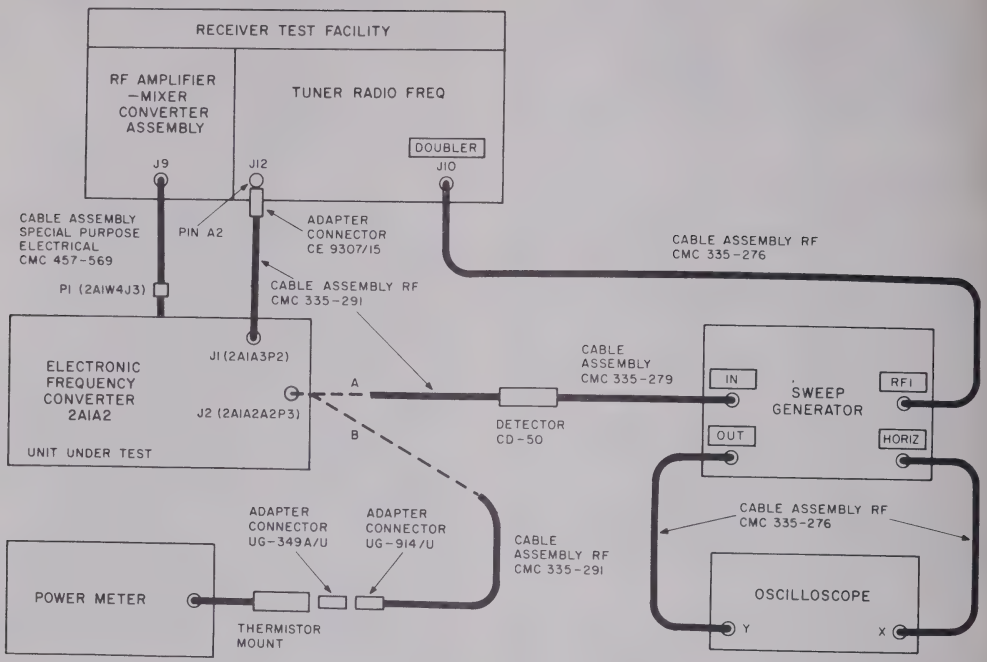


Figure 5-6. Bandpass filter assembly 2A1A2A3 and frequency multiplier 2A1A2A1 frequency tracking test set-up.

(*h*) Without changing the tuning of the filter, set the sweep generator SWEEP control to 48.3 MHz and check to see that the amplitude of the response is equal to the amplitude of the response at 72.5 MHz. Remove the top cover of frequency multiplier 2A1A2A1 and adjust R4 (fig. 4-143) if necessary.

(*i*) Refer to figure 5-7 and follow curve B from its highest point on through curve A by varying the sweep generator frequency and simultaneously tuning the bandpass filter assembly tuning gear. Check to see that no sudden changes in amplitude occur.

NOTE

Figure 5-7 shows the relationship between the signal generator frequency and the local oscillator (frequency multiplier) output frequency. The horizontal line between curves A and B corresponds to the change in multiplication factor from times-2 to times-3.

(*j*) To achieve good frequency tracking, slightly adjust L3(2A1A2A1) (fig. 4-143) at the low frequency end of the band and the flexible shaft linkage at the times-2 to times-3 frequency changeover point.

(*k*) Set the sweep generator to approximately 50 MHz and adjust the bandpass filter assembly tuning gear (fig. 5-5) for a display on the oscilloscope.

(*l*) Connect the power meter to J2 (2A1A2A2P3) (fig. 5-6B).

(*m*) Adjust C4(2A1A2A1) (fig. 4-143) to obtain maximum output. The power meter should indicate not less than +3 dbm.

(*n*) Vary the signal generator frequency in 2 MHz steps up to 72.5 MHz and peak the output by adjusting the bandpass filter tuning gear for each step. The output power should not be less than +3 dbm over the frequency range.

(*o*) Seal the setscrews on the flexible shaft as described in paragraph 4-12.

(*p*) Set test facility switch S1 to OFF.

(3) *Vswr measurements.*

(*a*) Install frequency mixer stage 2A1A2A2 and intermediate frequency amplifier 2A1A2AR1 (fig. 5-5) and secure the units in place with the screws provided.

(*b*) Connect the test equipment as shown in figure 5-8A.

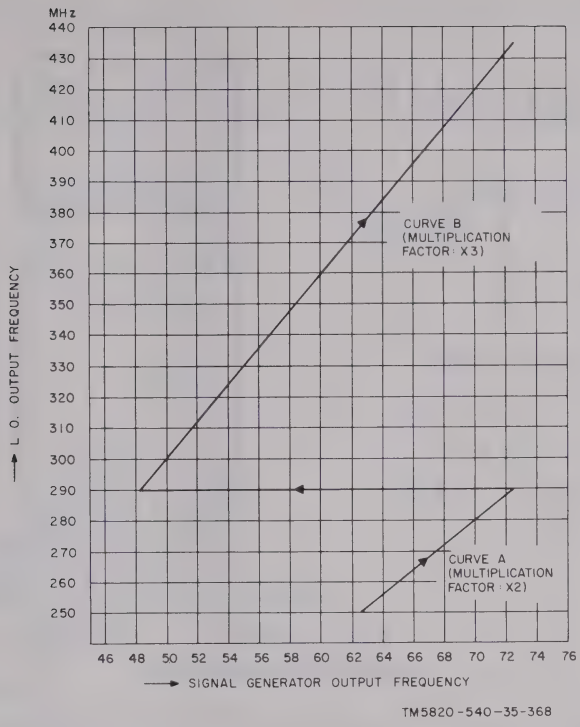


Figure 5-7. Bandpass filter 2A1A2A3 and frequency multiplier 2A1A2A1, frequency tracking curve.

(*c*) Adjust the sweep generator controls to obtain an output level of –10 dbm over the frequency range of 220 to 435 MHz.

(*d*) Disconnect the power meter from the VSWR detector and connect the calibrated mismatch in its place (fig. 5–8B).

(*e*) Calibrate the oscilloscope for a vswr of 2.0.

(*f*) Connect the VSWR detector to J3 of 2A1A2A3 (fig. 5–8C).

(*g*) Vary the sweep generator frequency slowly from 250 to 435 MHz and simultaneously turn the bandpass filter assembly tuning gear to maintain the response at peak amplitude. The vswr should be less than 2.0 over the frequency range.

(*h*) Connect the VSWR detector to J4 of bandpass filter assembly 2A1A2A3 (fig. 5–8D) and repeat (*g*) above.

(*i*) Reconnect P2(2A1A2A3J3) to J3 of bandpass filter assembly 2A1A2A3 (fig. 5–5).

(4) *Local oscillator level monitor (MULTIPLIER) check.*

(*a*) Set the sweep generator to CW and adjust the output level to +12 dbm.

(*b*) Connect the equipment as shown in figure 5–9.

(*c*) Set the test facility switches as follows:

Switch	Position
S1	ON
S5	S4
S4	ON
S6	MULTIPLIER

(*d*) Refer to figure 5–7, and tune the sweep generator over the frequency range of 73 to 48 MHz, simultaneously turning the tuning gear (fig. 5–5) to maintain a peak indication on test facility meter M1. The meter should indicate between 20 and 80 percent of full scale.

(*e*) Set test facility switches S4 and S6 to OFF.

(5) *Noise figure measurements.*

NOTE

The noise figure of the rf amplifier in the test facility must be checked and noted, before any noise figure test that uses the rf amplifier in the circuit is made.

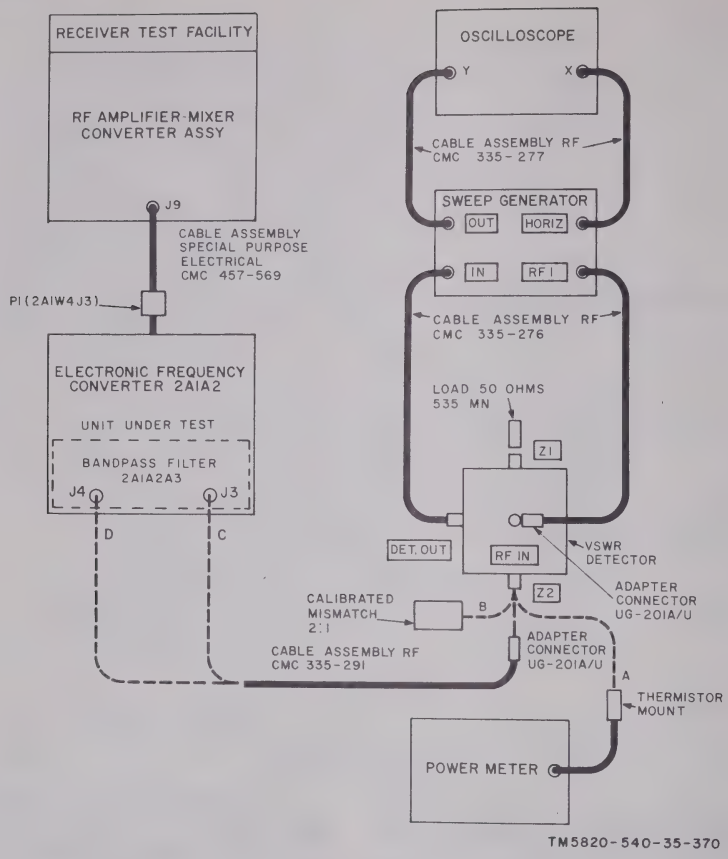


Figure 5-8. Electronic frequency converter 2A1A2, vswr test set-up.

(*a*) *Test facility rf amplifier noise figure.*

1. Connect the equipment as shown in figure 5–10.

2. Repeat paragraph 4–64*b*(3)(*b*) through (*j*).

3. Note the noise figure obtained above and repeat step *2* above with the signal generator tuned to 224, 300, 351 and 405 MHz in turn. Record the results obtained.

4. Set test facility switches S4 and S6 to OFF.

(*b*) *Electronic frequency converter 2A1A2 noise figure.*

1. Connect the equipment as shown in figure 5–11.

2. Set the test facility switches as follows:

Switch	Position
S4	ON
S6	MULTIPLIER
S8	63.46

3. Set the noise generator output level to zero.

4. Tune the electronic frequency converter by turning the tuning gear (fig. 5–5) for maximum deflection of test facility meter M1. The meter should indicate between 20 and 80 percent of full scale.

5. Set test facility switch S7 to MAN and RF AMPLIFIER MIXER CONVERTER ASSY GAIN control to maximum (fully clockwise).

6. Adjust the GAIN control on the test facility TUNER RADIO FREQ. for a –12 dbm indication on the power meter.

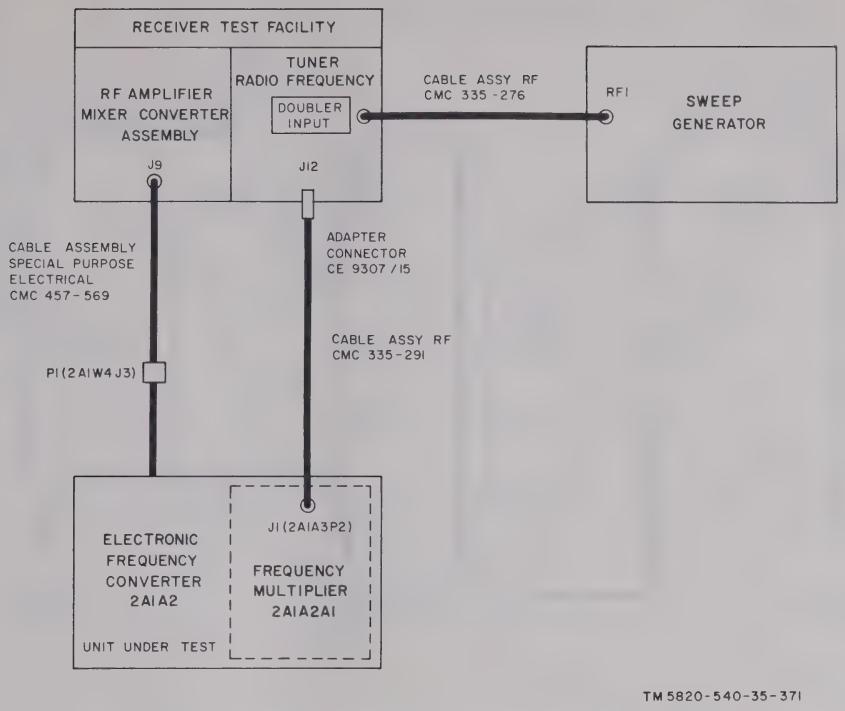


Figure 5-9. Local oscillator level monitor (MULTIPLIER) check, test set-up.

7. Reduce the GAIN control on the RF AMPLIFIER MIXER CONVERTER ASSM by 3 db for a –15 dbm indication on the power meter.

8. Increase the output level of the noise generator by 3 db as indicated on the power meter. Note the level of the noise figure on the noise generator meter.

9. Repeat subparagraph *3* through *8* above for SYNTHESIZER FREQUENCY MHz setting (S8 positions) 63.46, 54.98, and 72.5 (MHz). The noise figure should not exceed the figure calculated in *10* below.

10. To calculate the maximum noise figure for the test results in *8* and *9* above, add the test facility rf amplifier noise figure (para (*a*)*3* above) to the corresponding maximum converter noise figure obtained from the graph in figure 5–12. For example, if the test facility rf amplifier has a noise figure of 4 db, taken from the graph, the maximum converter noise figure permissible is 0.55 db. Therefore, the noise figure for the tests in *4* through *9* above should not exceed 4.0 db +0.55 db = 4.55 db.

5–13. Alignment of Radio Frequency Tuner 2A1

Radio frequency tuner 2A1 includes duplexer 2A1A1 and electronic frequency converter 2A1A2, each individually aligned. When assembled, the alignment of the radio frequency tuner is accomplished by tracking bandpass filter assembly 2A1A2A3 (part of 2A1A2) with the bandpass filter receive section, (part of duplexer 2A1A1) as described in paragraph 4–56*b*(3). Adjustment of channel frequency indicator 2A1A1–DS1 (RCVR CHANNEL) and 2A1A1DS2 (XMTR CHANNEL) may also be required; refer to paragraph 4–57*b*(6) and (7).

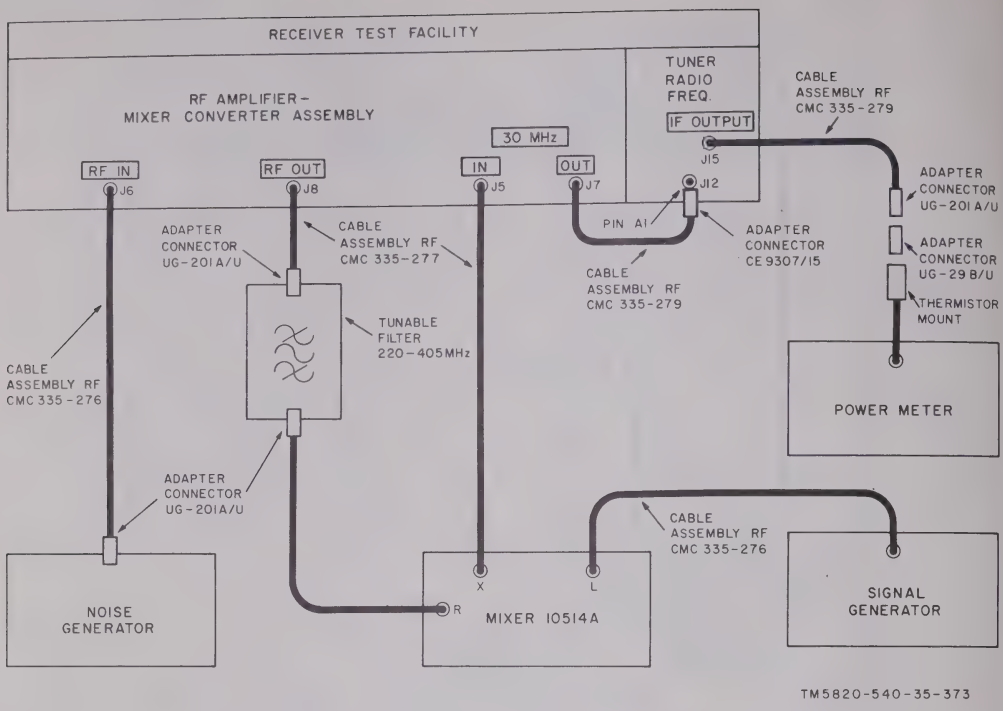


Figure 5-10. Test facility rf amplifier noise figure test set-up.

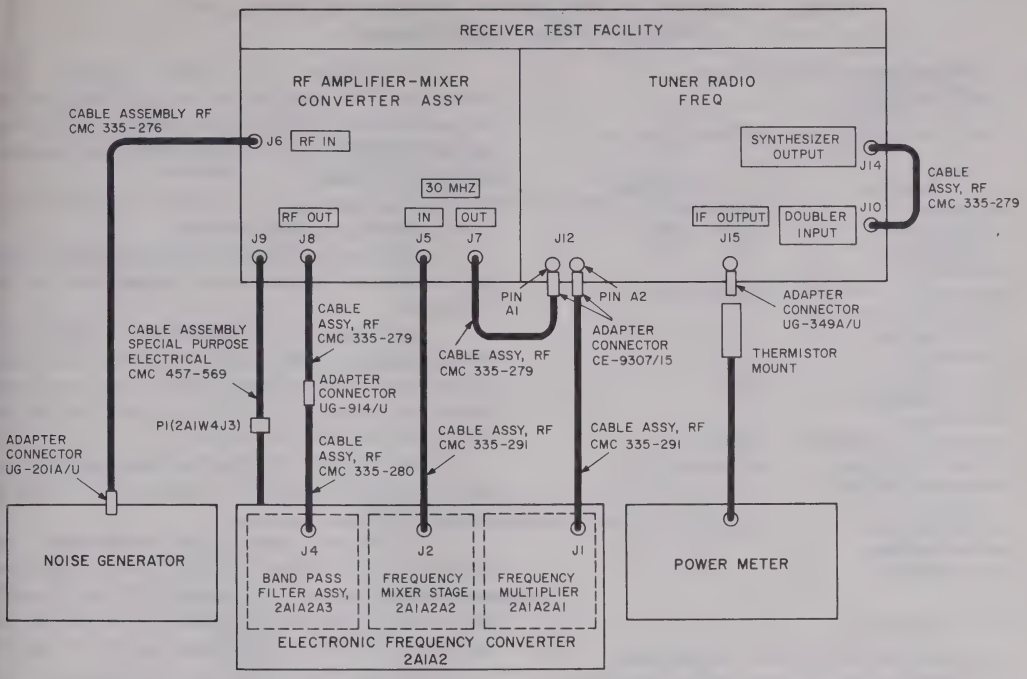


Figure 5-11. Electronic frequency converter 2A1A2 noise figure test set-up.

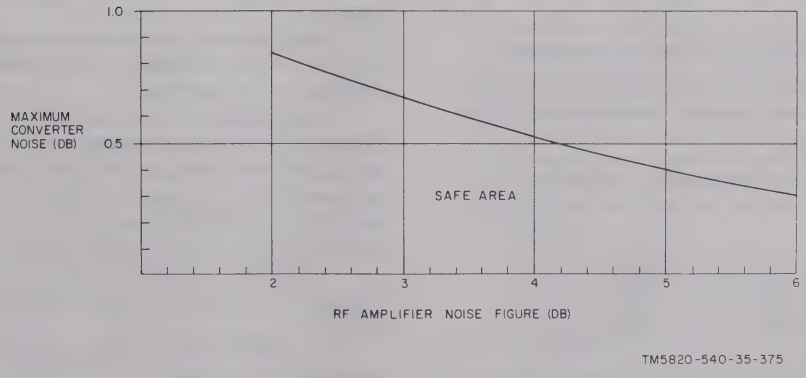


Figure 5-12. Electronic frequency converter 2A1A2 noise figure calculation graph.

Section IV. ELECTRICAL FREQUENCY SYNTHESIZER 1RE1A2 OR 5TR1A2 THERMAL ADJUSTMENTS

5–14. RF Oscillator 1RE1A2Y1 or 5TR1A2Y1

a. Test Equipment and Material Required.

Equipment	Common Name
Test Facility Transmitter TS-2866(V)1/ GRM-95(V)	Transmitter test facility
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit
Counter, Electronic Digital READOUT AN/USM-207	Counter
Oscilloscope AN/USM-281	Oscilloscope
Synthesizer Electrical Frequency 1RE1A2 or 5TR1A2	Synthesizer
Oven, Temperature-controlled Delta Design 6545R	Oven

b. Test Procedure.

(1) *Initial setting of unit under test.*

(*a*) Set L1 (fig. 4–12) to be flush with the coil former, then rotate clockwise 4 turns.

(*b*) Set R1 and R2 fully counterclockwise (at least 25 turns), then rotate R1 10 turns clockwise and R2 15 turns clockwise.

(*c*) Install the rf oscillator to be tested in the calibrated synthesizer using CMC 457–699 extender board.

(*d*) Place the synthesizer in the oven.

(*e*) Connect the test equipment as shown in figure 5–13 and proceed with the tests below.

(2) *Tests.*

(*a*) Set the test facility controls as shown below:

Switch	Position
S1	ON
S17	ON
S18	47.5

(*b*) Set the counter to 1 sec time base.

(*c*) Switch on the test chamber, and set the temperature control to –30°C. Allow 20 minutes for the temperature to stabilize.

NOTE

Temperature settings called for are nominal; ±2° C variation in temperature setting is allowed in each case.

(*d*) Monitor the output frequency and voltage at TP4. The output voltage displayed on the oscilloscope should be a square wave about 4v peak-to-peak. The counter should read approximately 0.5 MHz.

(*e*) Adjust L1 to obtain a 500,000-Hz ± 1 Hz indication on the counter.

(*f*) Feed a 100-kHz standard signal from the counter to the external trigger on the oscilloscope.

(*g*) Observe the waveform displayed on the oscilloscope while adjusting R2 for 500,000 Hz as indicated on the counter. The waveform should be locked to the time base of the oscilloscope and should not move.

(*h*) Set the test chamber temperature control to +75°C. Allow 20 minutes for temperature to stabilize.

(*i*) Monitor the output frequency and voltage at TP3 of the extender board. (This correspond to the pin 7 of output of the rf oscillator board). The output voltage displayed on the oscilloscope should be the same as in (*d*) above.

(*j*) Set the counter to 10 sec time base.

(*k*) Adjust R1 to set the frequency between the limits of 499,999.9 and 500,000.1 Hz as indicated on the counter.

(*l*) Feed a 100 kHz standard signal from the counter to the external trigger of the oscilloscope. The waveform should be locked to the time base of the oscilloscope and should not move.

(*m*) Set the test chamber temperature control to –30°C and allow the temperature to stabilize for 20 minutes.

(*n*) Monitor the output frequency and voltage at TP3 while feeding the 100 kHz standard signal into the oscilloscope. The frequency indicated on the counter should be 500,000.0 ±0.1 Hz. Adjust R2 if necessary. The waveform displayed on the oscilloscope should not move.

(*o*) Monitor the output frequency and voltage at –30°C, 0°C, +30°C, and +75°C, as follows:

1. Allow each temperature to stabilize for about 15 minutes.

2. Switch off the supply voltage for about 3 seconds.

3. Switch on the supply voltage and measure the frequency 5 seconds later. The total variation in frequency noted above should not be greater than 3 Hz, provided that the frequencies at –30°F and +75°C remain as in (*l*) and (*n*) above.

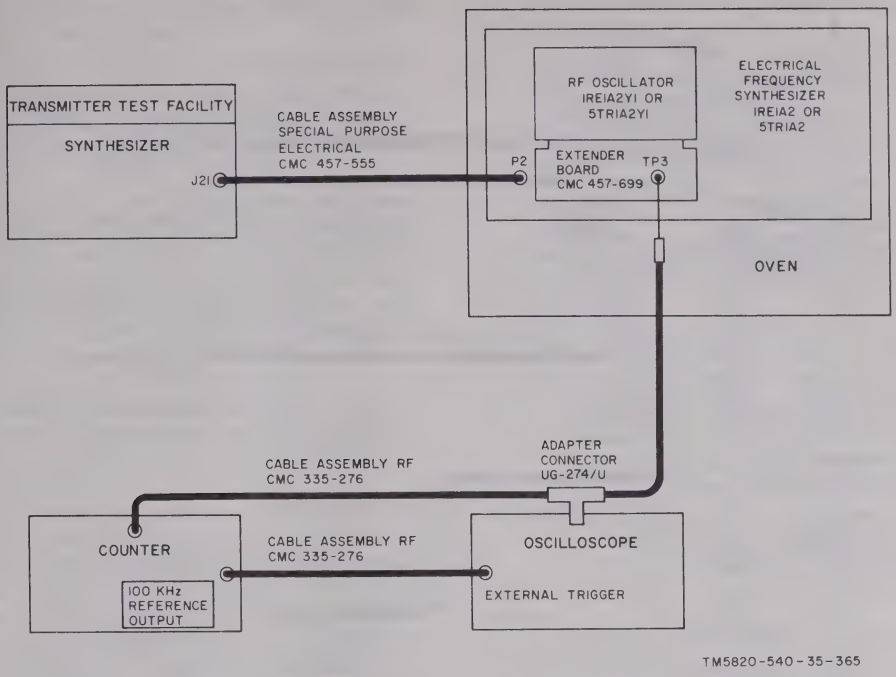


Figure 5-13. Rf oscillator board alignment.

5–15. Frequency Divider 1RE1A2A4 or 5TR1A2A4

a. Test Equipment and Material Required.

Equipment	Common Name
Accessory Kit, Test Facilities Set MK-1173(V)1/ GRM-95(V)	Accessory kit
Oscilloscope AN/USM-140	Oscilloscope
Generator Signal AN/USM-44A	Signal generator
Multimeter AN/USM-34 with 11042A probe coax "T" connector	Multimeter
Oven, Temperature-controlled Delta Design 6545R	Oven
Power Supply, Power Designs, Model 5015A	Power supply
Test Jig CMC T46338	Test jig
Adapter T72757	

b. Test Procedures.

(1) *Initial setting of controls.*

(*a*) Set R10, R18, and R26 (fig. 4–20) fully counterclockwise (at least 25 turns each).

(*b*) Set R10 20 turns clockwise and R18 15 turns clockwise. Do not adjust R26.

NOTE

It is always advisable to count the clockwise turns when adjusting R10, R18 and R26. At any period of adjustment R10 should be between 20–25 turns, R18 between 15–20 turns and R26 between 0–15 turns. If one stage proves to be difficult to adjust, try to adjust the preceding stage (i. e. increasing turns on R10 will ease the turn requirement of R18; always keep within the limits given above for the settings of R10, R18, and R26).

(2) *Initial calibration at room temperature.*

(*a*) Install the frequency divider under test into the T–46338 test jig and place it into the test chamber.

(*b*) Connect the test equipment as shown in figure 5–14.

(*c*) Set the test chamber temperature control to +20°C and allow it to stabilize for 5 minutes.

NOTE

Temperature settings called for are nominal; ±2° C variation is allowed in each case.

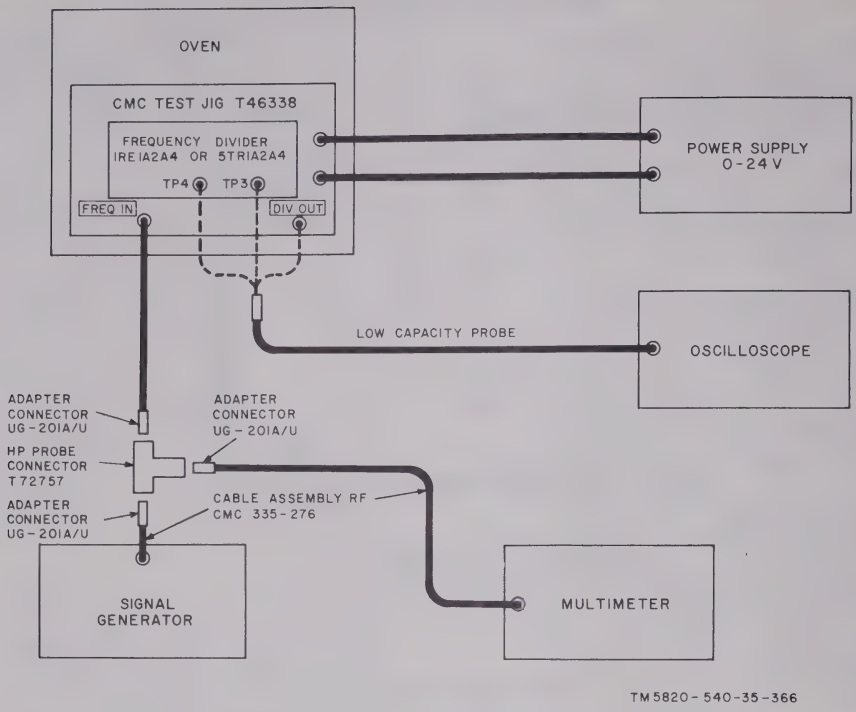


Figure 5-14. Frequency divider board alignment set-up.

(*d*) Adjust the power supply for a 8-volt supply voltage.

(*e*) Set the signal generator to 40 MHz at an output level of 1 volt rms as indicated on the multimeter. Set the oscilloscope to 0.1 usec time base.

(*f*) Monitor the signal at TP3 with the oscilloscope using the low capacity probe.

(*g*) Adjust R10 clockwise (count the turns) until a clean 20-MHz waveform is displayed on the oscilloscope (not necessarily sinusodial).

(*h*) Adjust the supply voltage to 8.2v.

(*i*) Monitor the signal at TP4 with the oscilloscope.

(*j*) Adjust R18 clockwise (count the turns) until a clear 10 MHz waveform (1 cycle per cm) first appears on the oscilloscope. Give R18 one more turn clockwise to insure proper operation.

(*k*) Adjust the supply voltage to 8.4v.

(*l*) Monitor the output from the DIV OUT connector on the test jig.

(*m*) Adjust R26 clockwise (count the turns) until the correct 5-MHz signal (1 cycle per 2 cm) first appears on the oscilloscope. Give R26 one more turn clockwise to insure proper operation.

(*n*) Vary the supply voltage from 8.5 volts to 15 volts and check to see that the output at DIV OUT is stable at the correct frequency.

(*o*) Set the signal generator frequency to 80 MHz and adjust the output level to 0.6 volts rms as indicated on the multimeter.

(*p*) Repeat (*d*) through (*n*) above and readjust R10, R18, and R26 if necessary.

(3) *Final calibration procedure.*

(*a*) Set the test chamber temperature control to +80°C and allow the temperature to stabilize for about 5 minutes.

(*b*) Set the signal generator to 40 MHz and adjust the output level to 1 volt rms as indicated on the multimeter.

(*c*) Monitor the signal at DIV OUT connector on the test jig.

(*d*) Vary the supply voltage from 10.2v to 13.8v. The output signal should remain stable and at the correct frequency.

(*e*) If the output fails proceed as follows:

1. Monitor the signal at TP4 and vary the supply voltage between 10.2v and 13.8v. If the correct signal (10 MHz) appears proceed to (*f*) below.

2. If the correct signal does not appear monitor the signal at TP3 and vary the supply between 10.2v and 13.8v. If the correct signal (20 MHz–2 cycles per cm) appears, proceed as in (*f*) below. If not, adjust R10 until the correct signal is displayed on the oscilloscope.

NOTE

Do not adjust R10 more than necessary. A half-turn margin is satisfactory. Too much margin will make it difficult to adjust over the complete temperature range.

(*f*) Monitor the signal at TP4 and vary the supply voltage between 10.2 v and 13.8v. Adjust R18 until the correct signal (10 MHz–1 cycle per cm) is displayed on the oscilloscope. Do not allow too much margin; an additional half turn should be sufficient. Vary the supply voltage to insure that the output remains stable.

(*g*) Monitor the signal at the DIV OUT connector. Vary the supply voltage between 10.2v to 13.8v and adjust R26 if necessary. The output (5 MHz–1 cycle per 2 cm) should remain stable throughout the voltage range.

(*h*) Again monitor the signal at TP4 and TP3 and vary the supply voltage between 10.2v and 13.8v to insure that the signal remains stable.

(*i*) Set the signal generator to 80 MHz at a 0.6-volt rms as indicated on the multimeter.

(*j*) Vary the supply voltage from 10.2v to 13.8v and monitor the signal at the DIV OUT connector. The correct signal displayed on the oscilloscope must be a 10-MHz stable waveform. If the correct frequency is not obtained, or it is not stable, monitor the signal at TP4 and TP3 in turn and adjust R18 and R10 respectively if necessary.

(*k*) Set the test chamber temperature control to –40°C and allow the temperature to stabilize for 5 minutes.

(*l*) Repeat steps (*b*) through (*h*) above for all test frequencies listed in table below.

Signal generator	
Frequency	Output level
40 MHz	1.0v rms
50 MHz	1.3v rms
60 MHz	1.1v rms
70 MHz	0.9v rms
80 MHz	0.6v rms

(*m*) Set the test chamber temperature to +80°C and allow the temperature to stabilize for 5 minutes.

(*n*) Repeat (*b*) through (*h*) above for all test frequencies listed in table above.

(*o*) If any adjustments were made to any of the resistors during (*l*) and (*m*) above, proceed as follows:

1. Set the test chamber temperature to –40°C, and allow the temperature to stabilize for 5 minutes.

2. Repeat (*b*) through (*j*) above.

3. Set the test chamber temperature to +80°C and allow the temperature to stabilize for 5 minutes.

4. Repeat (*b*) through (*d*) above.

(*p*) Normally at this point the temperature adjustment procedure should be completed. However, if R10, R18, and R26 have been overadjusted, it will be necessary to repeat the above procedure at –40°C and +80°C until the required results are obtained for a supply voltage range of 10.2v to 13.8v.

NOTE

Since binary dividers have a tendency to mode at the wrong frequency, be careful to correlate the binary frequency with the correct frequency of 20 MHz and 5 MHz.

(*q*) Set the test chamber temperature control to +20°C (room temperature) and allow the temperature to stabilize for 5 minutes.

(*r*) Monitor the signal at DIV OUT connector.

(*s*) Check for proper divider operation at frequencies of 40 MHz, 50 MHz, 60 MHz, 70 MHz and 80 MHz while varying the supply voltage from 10.2v to 13.8v.

Section V. REPAIR OF ANTENNA AS–1852/GRC–103(V) AND MAST AB–952/GRC–103(V) (ANTENNA SYSTEM)

5–16. Repair of Antenna AS–1852/GRC–103(V)

(fig. 5–15)

a. Disassembly of Reflector, Antenna AS–2150/GRC–103(V).

(1) Remove nuts (102) from flathead screws (101) to disassemble bracket (108) from corner reflector panel assembly (124). Push out roll pin (91) to remove the adjusting arms (92) and (93) from bracket (108).

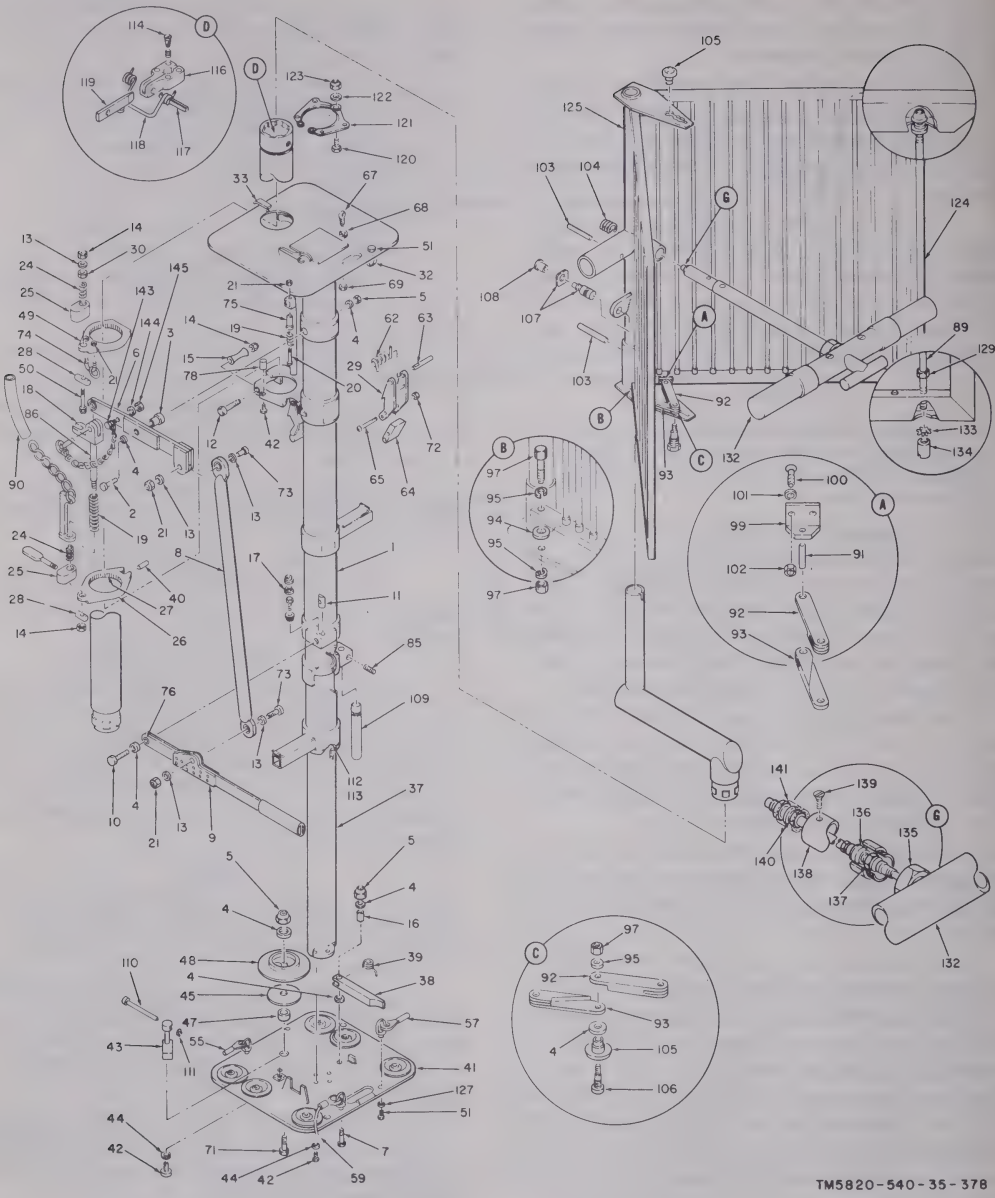


Figure 5-15. Antenna system, exploded view.

(2) Hold the head of stud (106) with a wrench and remove nut (97), then unscrew the stud from adjusting arm (92) or (93); remove handle (105).

(3) Loosen nut (97) and pull out screw (96) through washers (95), (94), and (95), to remove the adjusting arms.

(4) Pry out spring (104) from the support assembly (125), using a screwdriver.

(5) Remove adapter connector nut to release adapter connector (107) from tube support assembly (125).

(6) Push out roll pins (130).

(7) To remove a damaged reflector rod (89) from corner reflector (124), loosen nut (129); then loosen and remove nut (134) and lockwasher (133). Unscrew the reflector rod from the top anchor nut and pull out.

b. Disassembly of Dipole (132).

(1) Loosen and remove three flathead screws (139) at the connector end, and the connector mounting cap (141) will slide out.

(2) Loosen knurled nut (135) at the other end, and slide the dipole mounting tube out.

(3) Turn to disengage two mating connectors (136), and (137). Be careful not to pull too hard or the antenna element may become damaged.

(4) Change cable and connectors in accordance with standard procedures.

c. Assembly of Corner Reflector Tube.

(1) Assemble reflector rod (89) to the corner reflector assembly as follows:

(*a*) Slide nut (129) over the bottom end of relfector rod (89).

(*b*) Position reflector rod (89) between the top and bottom frame. Thread the reflector rod into the top anchor nut.

(*c*) Slip lockwasher (133) and nut (134) over the bottom end of the reflector rod; tighten nut (134). Tighten nut (129).

(2) Press roll pins (103) in place.

(3) Press spring (104) into tube support assembly (125).

(4) Assemble corner reflector panel assembly (124) to tube support assembly (125) as follows:

(*a*) Push screw (96) through washer (95), through the attachment hole in the tube support assembly to plastic washer (94), through attachment hole in the corner reflector panel assembly (124) and washer (95).

(*b*) Tighten with nut (97).

(*c*) Repeat at the other end of corner reflector panel assembly (124).

(*d*) Mount the second corner reflector panel assembly (124) as described in (*a*) through (*c*) above.

(5) Bring two adjusting arms (92) and (93) over the slot in the triangular bracket at the bottom of the corner reflector.

(6) Push stud (106) through handle (105) and washer (4) through the two adjusting arms (92) and (93), and washer (95), and tighten with nut (97).

NOTE

When replacing stud (106), the thread should be bottomed in the adjusting arm. Hold the stud with a wrench.

(7) Repeat (5) and (6) above for the two adjusting arms at the top of the corner reflector.

(8) Assemble each adjusting arm (92) and (93) at the top and bottom of the corner reflector assembly as follows:

(*a*) Push roll pin (91) through the small end of adjusting arm (92) or (93) into the attachment hole in bracket (108).

(*b*) Attach each bracket (108) to the corner reflector panel assembly using two flathead screws (100) washers (101) and nuts (102).

(9) Slip adapter connector (107) through the attaching hole in the bracket in tube support assembly (125) and tighten with the nut provided.

d. Assembly of Dipole.

(1) Mate connectors (136) and (137).

(2) Slide dipole mounting tube (138) over the cable and connectors; threaded position first.

(3) Fit knurled nut (135) over the threaded portion of the dipole mounting tube and tighten.

(4) Fit connector mounting cap (141) over the connector and fit it inside the mounting tube. Secure with three flathead screws (139).

e. Parts List for Figure 5-15.

Item No.	Part No.	Description
1	C70833	Sliding tube assembly
2	A71081-2	Bolt, hexagonal head
3	A70834	Bushing
4	A71082-9	Washer
5	A71081-5	Nut, Essna
6	B70835	Top lever assembly
7	A71082-2	Bolt, hexagonal head
8	B70515	Connecting rod
9	B70836	Operating lever assembly
10	A71082	Bolt, hexagonal head
11	A70921	Barrel nut
12	A71082-4	Bolt hexagonal head
13	A71082-8	Washer
14	A71081-4	Nut, Essna
15	A70214	Roller
16	A70837	Bushing
17	A70920	Level
18	B70838	Clevis assembly
19	A71082-13	Spring
20	A71134	Screw
21	A71081-3	Nut, Essna
24	B70208-4	Spring
25	B70253	Brake operator assembly
26	C70251	Operating ring
27	A70245	Brake lining
28	A70230	Actuating roller
29	B70247	Stop, actuating arm
30	A71082-11	Nut, hexagonal
32	A70922	Eye nut, heavy duty
33	A70893	Bracket assembly
37	B70843	Stationary tube assembly
38	A70844	Height adjustment handle

Item No.	Part No.	Description
39	A70845	Spring
40	A71033	Insert
41	C70846	Base plate assembly
42	A71082-19	Screw, hexagonal head
43	A70847	Lock assembly
44	A71082-20	Lock washer
45	A70848	Bearing plate
47	A70837-2	Bushing
48	B70850	Graduated disc assembly
49	C70251-2	Brake ring
50	A71081	Bolt, hexagonal head
51	A71082-3	Bolt, hexagonal head
55	B70924-1	Wire rope assembly
57	B70924-2	Wire rope assembly
59	B70924-3	Wire rope assembly
62	A71035	Torsion spring
63	A71036	Spindle
64	A70244	Feeler block
65	A71082-16	Screw, round head
66	A71080	Cover plate
67	A10000-15	Screw
68	A9974-67	Lockwasher
69	A9998-52	Nut
71	A71082-17	Bolt, hexagonal
72	A71081-6	Nut, Essna
73	A71546	Shoulder bolt
74	A71181	U bolt
75	A71190	Bushing
76	A70837	Bushing
78	A71215	Boss
85	A9978-103	Setscrew
86	A70250	Pip pin chain assembly
88	C70209	Tube and pivot torque lock assembly
89	A29658	Reflector rod
90	A71398	Sleeve
91	A9912-117	Roll pin
92	A70356-3	Adjusting arm
93	A70356	Adjusting arm
94	A29660	Washer, plastic
95	A71082-15	Washer
96	A71282-14	Screw
97	A71081-3	Nut, Essna
99	A29661	Bracket
100	A9997-33	Washer
101	A9988-12	Screw, flathead
102	A9979-45	Nut, Essna
103	A9912-84	Roll pins
104	A70830	Spring
105	B70826	Handle
106	A70357-2	Stud
107	A71233	Adapter, connector
108	A9869-19	CA Plug
109	A71184	Locating pin
110	A70884	Sliding handle
111	A9911-92	Snap ring
112	A70841	Bearing strip
113	A9995-6	Retaining screw
114	A9851	Screw flathead
116	A70899	Torque lock mounting body
117	A9912-79	Roll pin
118	A70897	Spring
119	A70900	Torque lock pivot arm assembly
120	A71082-21	Shoulder bolt
121	B70952	Guy ring segment
122	A71082-15	Washer
123	A71081-3	Nut, Essna
124	C71210	Corner reflector panel assembly
125	29662	Tube support assembly
127	A71082-6	Lockwasher
129	A9998-53	Nut
130	UG-572A/U	Connector
131	A9978-100	Setscrew
132	D70348	Dipole
133	A9928-21	Lock washer
134	A29657	Nut
135	A70972	Nut
136	UG-536B/U	Connector plug
137	UG-160D/U	Connector
138	B70974	Dipole mounting tube
139	A9995-8	Screw flathead
140	UG-704/U	Connector
141	A70978	Connector mounting end cap
142	A70265	Chain assembly
143	A71082-12	Screw round head
144	A71082-7	Lockwasher
145	A71082-10	Nut

5–17. Repair of Mast AB–952/GRC–103(V) (fig. 5–15)

a. Disassembly procedure.

(1) *Base plate area.*

(*a*) Loosen nut (5) at the end of hexagonal bolt (71). Remove washer (4), graduated disc (48), bearing plate (45), and bushing (47).

(*b*) Remove two hexagonal screws (42) and lock washers (44) to release lock assembly (43). Remove snap ring (111) to release sliding handle (110).

(*c*) Loosen nut (5) at the end of hexagonal bolt (7) and remove washer (4) and bushing (16) to release height adjustment handle (38) and spring (39).

(*d*) To remove any of wire rope assemblies (55), (57), and (59), loosen hexagonal bolt (51) from the eye nut of the wire rope assembly. Save lockwasher (127).

(2) *Removal of stationary tube assembly (3) from sliding tube assembly (1).*

(*a*) Loosen four hexaongal screws (42) and remove base plate assembly (41). Save four lockwashers (44).

(*b*) At the top of sliding tube assembly (1), loosen and remove nut (5) and washer (4) from the end of hexagonal bolt (2). Pull out the hexagonal bolt far enough to clear the inside diameter of the tube.

(*c*) Remove four nuts (69), lock washers (68), and screws (67) that secure the top cover plate (66).

(*d*) Slide stationary tube (37) out through the top of sliding tube assembly (1).

(3) *Disassembly of sliding tube assembly (1).*

(*a*) Remove setscrew (85) and press locating pin (109) out of the socket.

(*b*) Remove retaining screw (113) and remove bearing strip (112) (in two halves) from the bearing groove inside the sliding tube.

(*c*) Turn the collar counterclockwise, remove the plastic transparent portion of level (17) and remove the screw that secures the level base.

(*d*) Remove nut (14) from hexagonal bolt (12) and release roller (15).

(*e*) Remove nut (72) from the end of screw (65), to remove feeler block (64) from stop actuating arm (29).

(*f*) Remove the adjacent rollers (15) as described above; remove spindle (63) and torsion spring (62) and remove the stop actuating arm (29) from the sliding tube assembly (1).

(*g*) Loosen hexagonal screw (42) and remove boss (78).

(*h*) Loosen and remove nut (21) from the end of screw (20) and remove bushing (75) and spring (19).

(*i*) Loosen eye nut (32) and remove bracket assembly (33).

(*j*) Remove hexagonal bolt (51) and bolt (51) and lockwasher (127) to release eye nut (32).

(4) *Disassembly of jacking mechanism.*

(*a*) At the top of sliding tube assembly (1), remove nut (5) and washer (4) from the end of hexagonal bolt (2). Slide hexagonal bolt (2) through the tube, remove bushing (3) and washer (4) and release top level assembly (6) from sliding tube assembly (1).

(*b*) At the lower section of the jacking mechanism loosen and slide out hexagonal bolt (10) through washer (4) and bushing (76) to release operating lever assembly (9). Remove barrel nut (11) from the square inset.

(*c*) Loosen and remove nut (21) and washer (13) from the end of shoulder bolt (73). Slide shoulder bolt (73) through operating lever assembly (9), connecting rod (8) and washer (13).

(*d*) Loosen and remove nut (21) and washer (13) and slide shoulder bolt (73) through top lever assembly (6), connecting rod (8) and washer (13).

(*e*) Loosen and remove nut (14). Remove washer (14), then loosen and remove nut (30). Slide hexagonal screw (50) through spring (24), brake operator assembly (25), brake ring (49) and top actuating roller (28).

(*f*) Remove two nuts (21) to disassemble the U bolt (74) from the brake ring.

(*g*) Loosen and remove nut (14) and bottom actuating roller (28). Slide clevis assembly (18) upward to release the operating ring (26), bottom brake operator assembly (25), spring (24), sleeve assembly (90), and spring (19).

(*h*) Push out insert (40) from operating ring (26).

(*i*) Pry out brake lining (27) with screwdriver or other sharp tool.

(5) *Mast section assembly.*

(*a*) Loosen four flathead screws (114) and remove torque lock assembly (D) from the tube and pivot torque lock assembly (88).

(*b*) Remove roll pin (117) from torque lock mounting body (116) to release torque lock pivot arm assembly (119) and spring (118).

(6) *Guy ring assembly.* Disassemble guy ring segment (121) by removing nut (123) and washer (122) from shoulder bolt (120).

b. Assembly of Antenna Mast.

(1) *Base plate area.*

(*a*) Assemble graduated disc assembly (48) as follows:

1. Push hexagonal bolt (71) through the hole in the base plate (41).

2. Place bushing (47), bearing plate (45), graduated disc (48) and washer (4) on bolt (71).

3. Tighten with nut (5).

(*b*) Assemble lock assembly (43) as follows:

1. Push sliding handle (110) through the hole in item (43) and place snap ring (111) in the slot provided.

2. Position lock assembly (43) over the two holes in base plate assembly (41).

3. Secure with two hexagonal screws (42) and lockwasher (44).

(*c*) Assemble height adjustment handle (38) as follows:

1. Push hexagonal bolt (7) through the hole in the base plate (41) and place washer (4) on it.

2. Place spring (39) within height adjustment handle (38) and place both on the hexagonal bolt.

3. Position spring (39) so that the long end bears against the welded tab on the base plate and the short end against the height adjustment handle.

4. Place bushing (16) and washer (4) over the height adjustment handle and tighten nut (5).

NOTE

When properly installed, the spring tends to move the height adjustment handle toward stationary tube assembly (37).

(*d*) Install wire rope assemblies (56), (57), and (59) as follows:

1. Position the eye nut at the end of the wire rope assembly over the corresponding hole in base plate (41).

2. Push hexagonal bolt (51) through lockwasher (127) and base plate (41) hole into the wire rope assembly eye unit.

3. Tighten hexagonal bolt (51).

(2) *Installation of stationary tube assembly (37) into sliding tube assembly (1).*

(*a*) Remove top lever assembly (6) of the jacking mechanism assembly, if still attached to the sliding tube.

(*b*) Place stationary tube assembly (37) into sliding tube assembly (1) through the top opening.

(*c*) Replace top cover plate (66) and secure it in place with four screws (67), lockwashers (68), and nuts (69).

(*d*) Replace base plate assembly (41) and secure it in place with four hexagonal screws (42) and lockwashers (44).

(*e*) Attach top lever assembly (6) of the jacking mechanism assembly as described in (4) below.

(3) *Reassembly of sliding tube assembly* (1).

(*a*) To reassemble bearing strip (112), stationary tube assembly (37) must be removed (*a*(2) above). Place the two halves of bearing strip (112) in the bearing holder groove. Tighten retaining screw (113). Replace the stationary tube assembly (37) (*b*)(2) above).

(*b*) Push locating pin (109) into its socket and secure with setscrew (85).

(*c*) Position the base of disassembled level (17) over its mounting hole and secure with the screw provided. Replace the transparent plastic portion of the level and the collar; turn the collar clockwise.

(*d*) To install roller (15) place hexagonal bolt (12) through the hole in the bracket and through roller (15) and tighten with nut (14).

NOTE

Tighten nut (4) until it is just snug. Over tightening will bend the bracket and lock the roller.

(*e*) Position feeler block (64) into stop actuating arm (29); push screw (65) through the stop actuating arm and feeler block and tighten with nut (72).

(*f*) Position the stop actuating arm in place and push spindle (63) through the top holes of stop actuating arm (29) and torsion spring (62).

NOTE

When correctly installed, torsion spring (62) causes stop actuating arm (29) to swing away from sliding tube assembly (1).

(*g*) Position boss (78) over the mounting hole and secure in place with hexagonal screw (42).

(*h*) Position bracket assembly (33) in place and secure with eye nut (32).

(*i*) Position the second eye nut (32) on the opposite side of the top plate assembly and tighten with hexagonal bolt (51) and lockwasher (127).

(4) *Reassembly of jacking mechanism.*

(*a*) Install connecting rod as follows:

1. Push shoulder bolt (73) through washer (13), one end of the connecting rod (8), operating lever assembly (9), washer (13), and tighten with nut (21).

2. Place the other end of connecting rod (8) in the slot provided at the end of top lever assembly (6) and push shoulder bolt (73) through washer (13), top lever assembly (6), connecting rod (8), and washer (13).

3. Tighten with nut (21).

(*b*) Attach the operating lever assembly (9) to the sliding tube assembly (1) as follows:

1. Push bushing (76) into the hole of operating lever assembly (9).

2. Place barrel nut (11) inside the hole of the welded collar.

3. Push hexagonal bolt (10) through washer (4) and bushing (76) and tighten into the barrel nut.

(*c*) Attach top lever assembly (6) to sliding tube assembly (1) as follows:

1. Push bushing (3) into the hole of top lever assembly (6).

2. Push hexagonal bolt (2) through washer (4), bushing (3), and through the holes at the top of the sliding tube assembly.

3. Place washer (4) over the protruding end of hexagonal bolt (2) and tighten with nut (5).

(*d*) Replace brake lining (27) in brake ring (49) or operating ring (26) as follows:

1. Place the ring on a flat working surface.

2. Meet the two ends of the brake lining insert at the side of the brake or operating ring 90° away from the ring attachment hole.

3. Tuck brake lining (27) into the groove on one side of the ring and, using a screwdriver, progressively work the other edge of the insert into the groove.

(*e*) Slip sleeve (90) over the chain and pass the last chain ring over U bolt (74). Place U bolt (74) on brake ring (59) and tighten with two nuts (21).

(*f*) Press insert (40) into the groove of operating ring (26).

(*g*) Assemble brake ring (49) as follows:

1. Push hexagonal bolt (50) through actuating roller (28), through the brake ring (49) attachment hole, through brake operator assembly (25), and through spring (24).

2. Place nut (30) over the end of hexagonal bolt (50) and turn it to the end of the threaded portion.

3. Place washer (13) and nut (14) over the end of hexagonal bolt (50).

(*h*) Install clevis assembly (18) as follows:

1. Push clevis assembly (18) through spring (19), sleeve assembly (90), spring (24), brake operator assembly (25), operating ring (26) attachment hole, and actuating roller (28).

2. Tighten with nut (14) to the end of the threaded portion of clevis assembly (18).

(*i*) Attach the pip pin chain (86) to the top lever assembly (6) with screw (143) washer (144) and nut (145).

(5) *Mast section assembly.*

(*a*) Place torque lock pivot arm assembly (19) into the torque lock mounting body (116) and push roll pin (117) through spring (118) and torque lock mounting body.

(*b*) Position the torque lock assembly on the mast section assembly with the spring (119), pushing the free end of the torque pivot arm away from the tube.

(*c*) Secure in place with four flathead screws (114) provided.

(6) *Guy ring segment (121).* To assemble guy ring segment (121) push shoulder bolt (120) through the two sections of the guy ring and tighten with washer (122) and nut (123).

5–18. Antenna AS–1852/GRC–103(V), Cable Assemblies RF CG–3443/U (50 ft) and (25 ft) VSWR Tests

a. Test Equipment and Material Required.

Equipment	Common Name
Generator, Sweep Signal AN/USM-203	Sweep Generator
Oscilloscope AN/USM-281	Oscilloscope
Accessory Kit, Test Facility MK-1173(V)1/ GRM-95(V)	Accessory Kit
Adapter-Connector UG-643/U	Adapter

b. VSWR Check of Antenna.

(1) Connect the test equipment as shown in figure 5–16A. Use the 1:1 calibrated load at port Z2 of the VSWR detector (with cable and adapters).

(2) Set the sweep generator to obtain a flat response over the 220 MHz to 405 MHz frequency range as displayed on the oscilloscope.

(3) Replace the calibrated load with the 1.75:1 calibrated mismatch. Mark the vswr trace as displayed on the oscilloscope.

(4) Insure that the antenna is pointed toward a relatively large open area to keep reflections to a minimum.

(5) Replace the 1.75:1 calibrated mismatch with the unit under test as shown in figure 5–16B. The vswr response as displayed on the oscilloscope should be within the limits of the markings on the graticule.

(6) Observe the display while rotating the unit under test by about 45° to check for reflection effect.

NOTE

If necessary, select a more open area and repeat (6) above.

(7) In the event of excessive vswr, check the adapters, cables, and the dipole itself.

c. VSWR Check of Cable Assembly CG–3443/U (50 ft) or (25).

(1) Set up the test equipment as shown in figure 5–16A.

(2) Use the 1:1 calibrated load and adjust the sweep generator to obtain a flat response over the 220 MHz to 405 MHz frequency range as displayed on the oscilloscope.

(3) Replace the calibrated load with the 1.4:1 calibrated mismatch and adjust for a suitable display on the oscilloscope. Mark the vswr trace displayed.

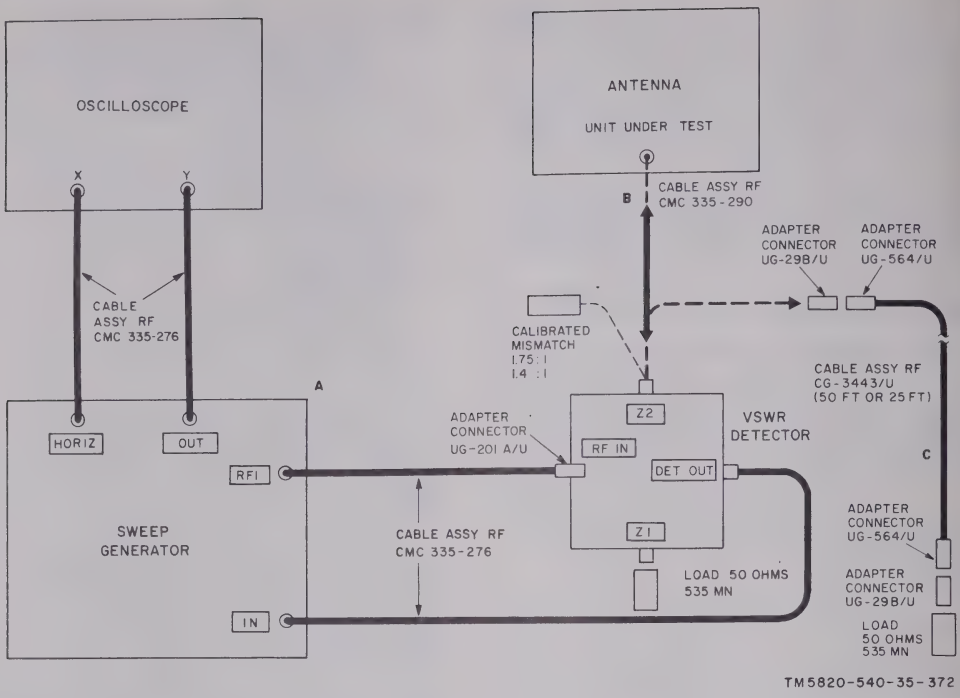


Figure 5-16. Antenna and rf cable vswr test set-up.

(4) Replace the 1.4:1 calibrated mismatch with the cable under test as shown in figure 5-16C. The vswr as displayed on the oscilloscope should be not greater than 1.34. Interpolate on the oscilloscope graticule to obtain the actual trace.

(5) Uncoil the cable under test and observe that the vswr trace does not change.

Section VI. ROTATIONAL SPEED TEST, CENTRIFUGAL FAN 5A2B1

5-19. Test Equipment and Material Required

Equipment	Common name
Test Facility, Transmitter TS-2866(V)1/ GRM-95(V)	Transmitter test facility
Accessory Kit, Test Facility MK-1173(V)1/ GRM-95(V)	Accessory kit
Tachometer, Stroboscopic	Strobotac

5-20. Test Procedure

a. Connect equipment as shown in figure 5-17.

b. Switch on the strobotac.

c. Set test facility switch S1 to ON.

d. Set and hold test facility switch S19 to TEST for one minute. Using the strobotac, observe the fan speed which should be as shown below.

(1) Torrington fans—10,000 rpm ± 250 rpm

(2) IMC fans —10,500 rpm + 250 rpm

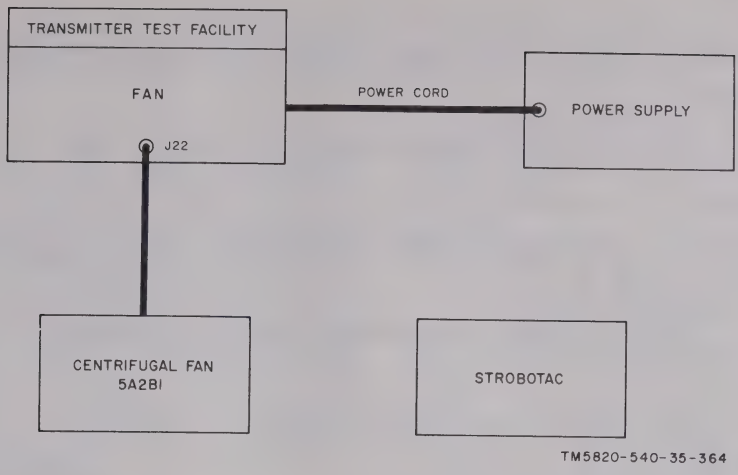
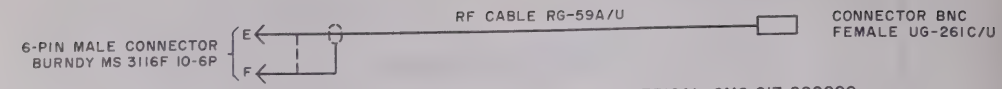
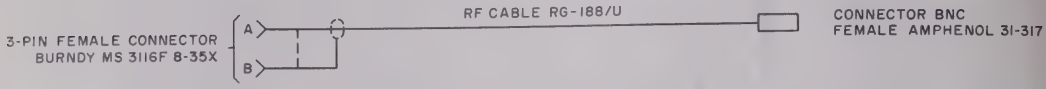


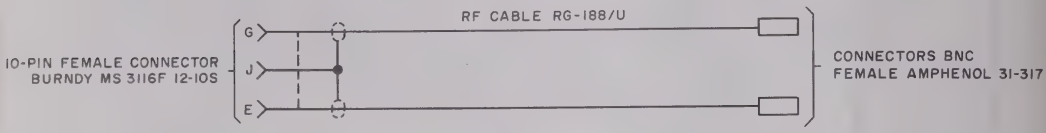
Figure 5-17. Centrifugal fan 5A2B1, test set-up.



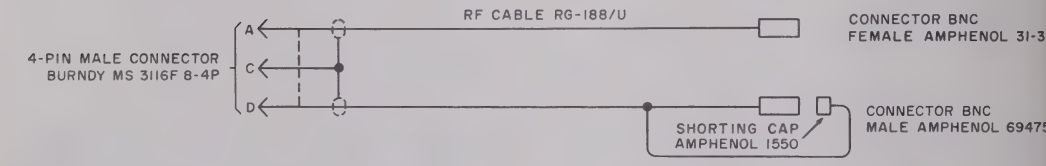
A. CABLE ASSEMBLY, SPECIAL PURPOSE ELECTRICAL CMC 217-800009



B. CABLE ASSEMBLY, SPECIAL PURPOSE ELECTRICAL CMC 217-800010



C. CABLE ASSEMBLY, SPECIAL PURPOSE ELECTRICAL, BRANCHED CMC 217-800011



D. CABLE ASSEMBLY, SPECIAL PURPOSE ELECTRICAL, BRANCHED CMC 217-800012

E. CABLE ASSEMBLY RF CMC 217-800013

TM5820-540-35-380

Figure 5-18. Special-purpose cables, depot-fabricated.

Transmitter test facility

Receiver test facility

Accessory kit

Section VII. REPAIR OF AMPLIFIER-FREQUENCY MULTIPLIER AM-4321/GRC-103(V) AND AMPLIFIER-CONVERTER AM-4317/GRC-103(V) (BAND II RF HEADS)

5-21. General

This section provides depot maintenance information for the band II RF heads. The alignment, disassembly, and asembly provedures given follow from the appropriate test procedures given in chapter 4. The disassembly procedures are lengthy and presume that complete disassembly is required. The repairman should evaluate the unit under test before disassembly, and if complete disassembly is not required, only relevant sections of the text should be used. If the repairman is not familiar with the unit under repair, the unit and the mechanical drawing should be studied together so that interactions and sequences will be known after disassembly.

5-22. Additional Test Equipment Required

The following tables list the eequipment, special tools, and materials required for maintenance of the band II RF heads in addition to that given in paragraph 5-2.

NOTE

The Bridge Impedance-Dummy Load 1174/U contained in the Accessory Kit Test Facilities Set MK-1173(V)1/GRM-95(V) consists of—

VSWR Detector TRB-3
Calibrated Mismatch TRM-1-1.00F
Calibrated Mismatch TRM-1-1.20F
Calibrated Mismatch TRM-1-1.25F
Calibrated Mismatch TRM-1-1.50F
Calibrated Mismatch TRM-1-1.75F
Calibrated Mismatch TRM-1-2.00F
Calibrated Mismatch TRM-1-2.50F

a. Test Equipment and Material Required.

Equipment	Common name
Generator, Signal SG-409/U	Signal generator No. 1
Generator, Signal SG-340A/U	Signal generator No. 2
Generator, Signal AN/USM-205.	Wide range oscillator
Meter, Frequency AN/USM-159.	Frequency meter
Generator, Sweep SG-888	Sweep generator
Detector, RF XD-23	Detector XD-23A
50-ohm load Omni Spectra 20020P (2 required).	50-ohm load OS20020P
Shorting Termination Omni Spectra 20140.	Shorting termination
Filter, Low-Pass TLC-1000-5EF.	Low-pass filter
Adapter-Connector Omni Spectra 21020.	Adapter-connector OS21020

b. Special Tools and Materials.

220 inch-ounce torque screwdriver
Instrument lubricating oil MIL-L-6085
Aircraft and instrument grease MIL-G-23827
Locking and retaining compound MIL-S-22473
Coupling probe SM-D-696038
Coupling probe SM-D-696040
Short circuit tool SM-B-696036
Short circuit tool SM-B-696037 (2 required)

5-23. Disassembly and Assembly of Radio Frequency Amplifier 37AR1AR1

a. General.

(1) Carefully examine the amplifier before disassembly, notice the relationship between the moving parts, and try to determine the parts which will be replaced.

(2) When as assembly of parts has been removed and is clearly serviceable, ignore the relevant disassembly instructions and proceed with the disassembly of the main unit.

(3) Disassemble the unit until the part to be replaced has been removed. Locate the reference to that part in the assembly procedures and start the reassemly from there.

(4) Disassembly and assembly procedures are provided for the output stage only. However, the output and driver stages are identical so the procedures can be applied to either stage or both stages.

(5) To remove a flanged bearing proceed as follows: Use a plastic rod with a diameter less than that of the bearing to be removed. Place the rod against the bearing, on the opposite side to the flange, and gently tap the rod with a hammer until the bearing drops out.

(6) When a pinned gear is replaced, the shaft should be replaced. To pin a gear to a shaft, proceed as follows: Position the gear on the shaft and secure it with a setscrew. Support the shaft, drill through the hub and shaft, and press the pin home. Remove the setscrew.

(7) Apply a light film of instrument lubricating oil (MIL–L–6085) to the drive screws and use aircraft and instrument grease (MIL–G–23827), sparingly, to lubricate the gears.

(8) Before disassembly use a soldering iron to soften the compound sealing the setscrews. After completion of the electrical tests (para 4–112), apply sealing, locking and retaining compound (MIL–S–22473) to all setscrews.

b. Special Tools and Materials.

220 inch-ounce torque screwdriver
Instrument lubricating oil MIL–L–6085
Aircraft and instrument grease MIL–G–23827
Locking and retaining compound MIL–S–22473

c. Disassembly Procedures.

(1) *Removal of XMTR TUNE drive mechanism* (fig. 5–19).

(*a*) Remove nut (1) and washer (2) and disengage sprocket wheel (25) from roller chain (27).

(*b*) Remove three screws (3) and washers (4) and remove bearing retaining plate (5). remove bearing (15) and (23) busing (28).

(*c*) Remove the spring clip from the connector link of chain (27) and remove the chain.

(*d*) Remove pins (7), (12) and (16), spur gears (8), (13) and (17), and shafts (10) and (14).

(*e*) Loosen setscrew (20) and remove spur gear (21) and shaft (19).

(*f*) Remove headed shoulder pin (24), sprocket wheel (25) and clutch disk (26).

(*g*) Loosen setscrews (29) and (32), and remove spur gear (30), sprocket wheel (33), and woodruff keys (31) and (34).

(*h*) Loosen two setscrews (113) and remove sprocket wheels (112) and woodruff keys (111).

(*i*) Loosen two setscrews (35) and remove sprocket wheels (36) and woodruff keys (37).

(*j*) Remove the three red-circled screws (55) and washers (56) securing channel-frequency indicator (38) and remove the indicator. Remove pin (39) and flexible shaft (40).

(*k*) Remove three pins (41). Remove shaft (42), beveled gear (43), collar (44), and beveled gear (47). Remove bearings (45) and (46).

(*l*) Not used.

(*m*) Remove 14 screws (49) and washers (50) which secure the external cavities and the connector blocks (fig. 5–20, items 40 and 47) to center plate (57).

(*n*) Remove two screws (51), washers (52), terminal lugs (53), and bushing insulators (54).

(*o*) Unsolder and tag the leads connected to C5, C6, C12, and C13 and remove the capacitors.

(*p*) Unsolder and tag the wires connected to C7 and C14 (fig. 5–20, item 43).

(*q*) Remove electronic tubes V1 and V2.

(*r*) Remove pin (59), spur gear (60), shaft (61) and bearings (48) and (58).

(*s*) Carefully pull center plate (57) away from the rear plate (fig. 5–20, item 42) to separate the inner cavities from the outer cavities.

(*t*) Remove washer (62) and bearing (63). Loosen setscrew (64) and remove spur gear (65) and woodruff key (66).

(*u*) Remove two shims (67) and bearings (68). Remove bearings (6), (11), (18) and (22).

(2) *Removal and disassembly of capacitor probe assemblies* (fig. 5–19).

(*a*) Remove pin (108), withdraw drive screw (110), remove worm gear (109).

(*b*) Loosen three red-circled screws (105) and lift housing (106) clear of the cavities. Remove bearing (107).

(*c*) Remove two screws (89) and washers (90) and lift guide block (92) straight up.

(*d*) Loosen two setscrews (91) and remove guide block (92).

(*e*) Remove two screws (93) and remove cover (94).

(*f*) Unsolder connection between probe (95) and the coaxial connector (part of probe holder (103)) and remove the probe.

(*g*) Remove bushing insulator (104), garter extension spring (96), bearing (97), bushing (98), helical gear (99), washer (100), bearing (101), and sleeve (102).

(*h*) Remove pins (69) and (70), withdraw shaft (71) and remove helical gear (75), beveled gear (74), four keyed washers (73), and collar (72). Remove bearings (76) and (77).

(*i*) Remove pins (78), (79), (80), and (81). Withdraw shaft (82) and remove helical gear (83), collar (84), worm gear (87), and beveled gear (88). Remove bearings (85) and (86).

(3) *Disassembly of inner cavity* (fig. 5–20).

(*a*) Remove four screws (45) and washers (46) securing the cavity (4) to the center plate (fig. 5–19, item 57).

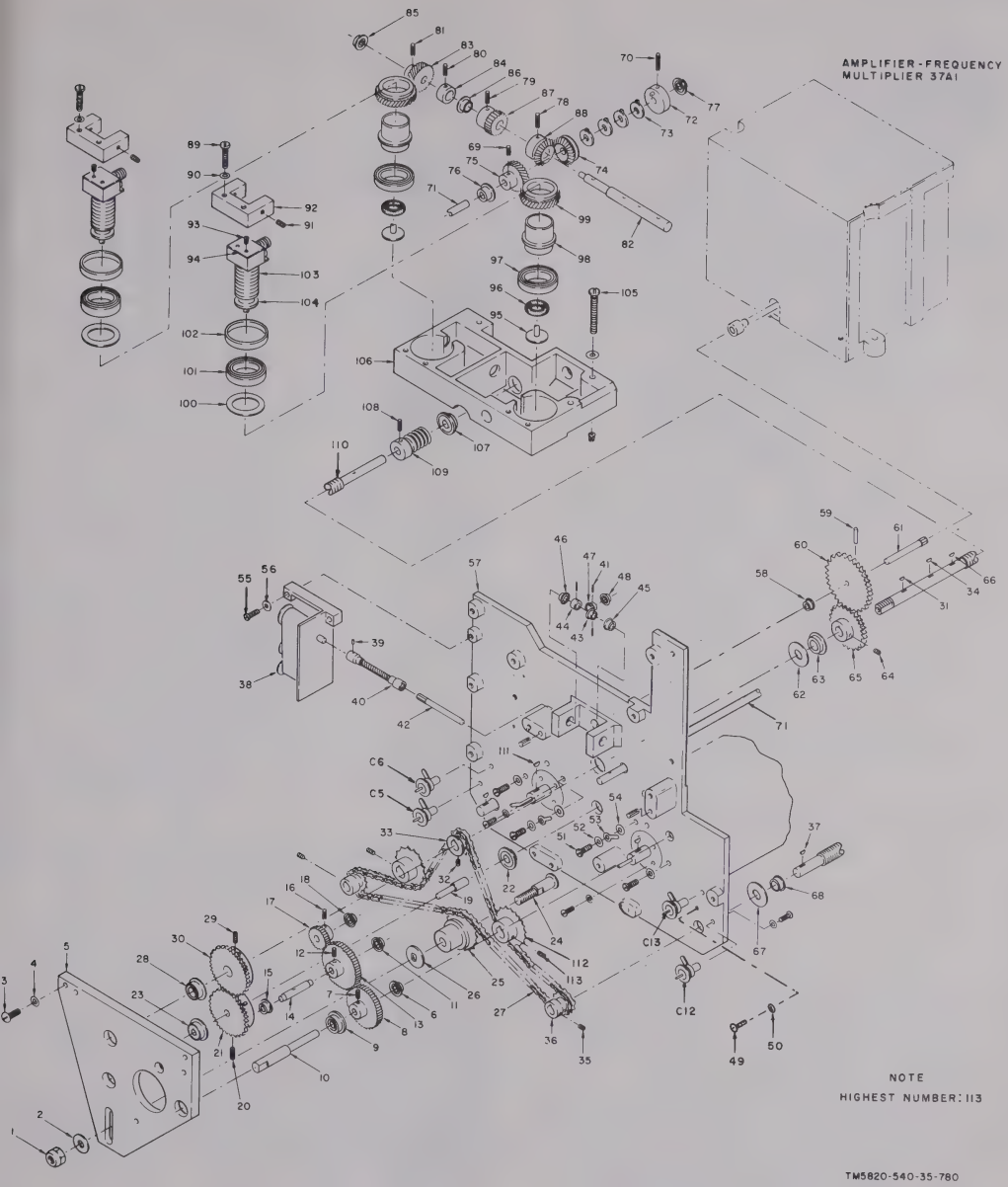


Figure 5-19. Radio frequency amplifier, 37AR1AR1, tuning mechanism exploded view.

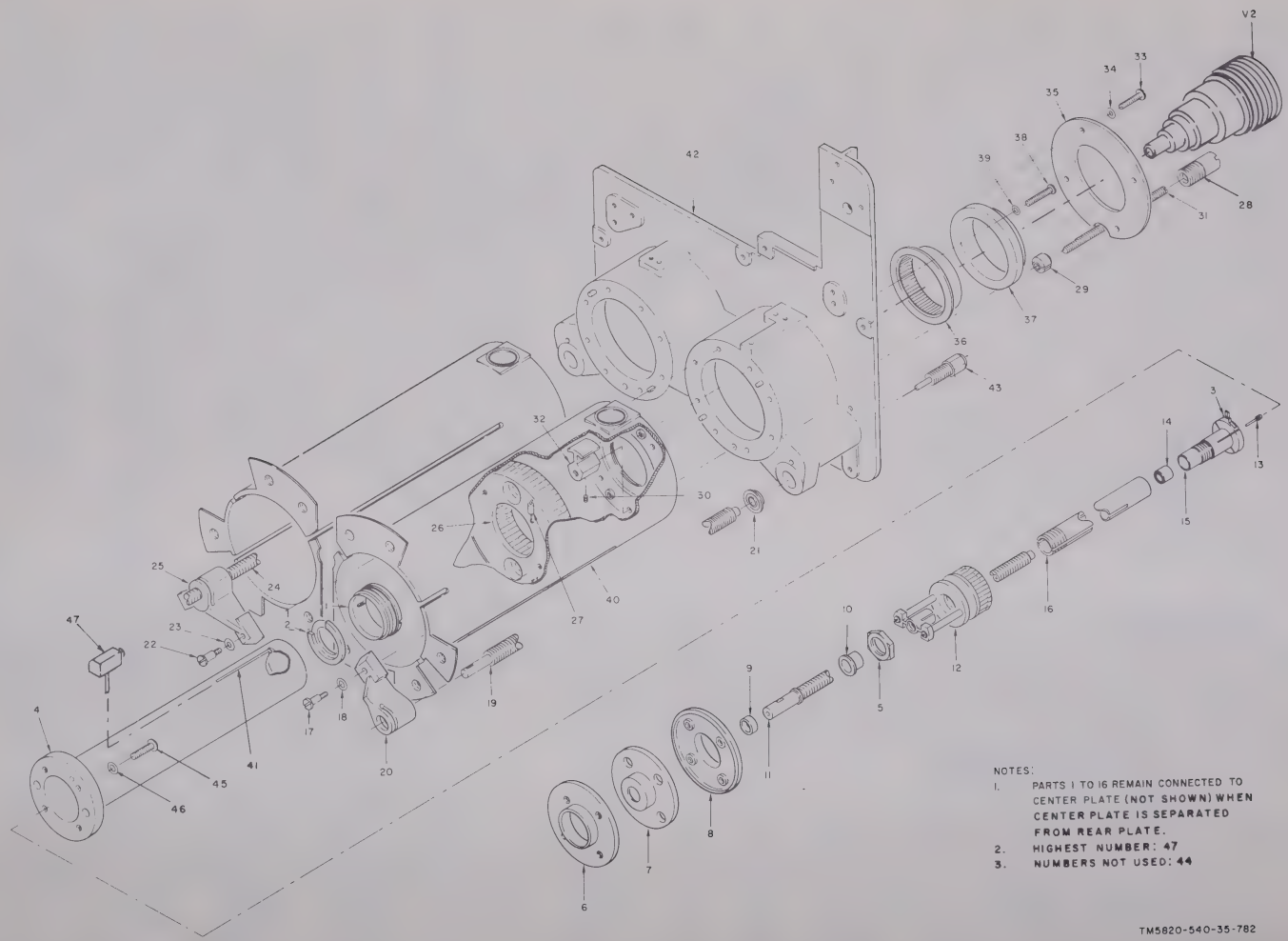


Figure 5–20. Radio frequency amplifier 37AR1AR1, cavity exploded view.

(*b*) Remove electrical contact assembly (1) and insulator bushing (2).

(*c*) Unsolder electrical contact (3) from cable (41) and electrical contact assembly (15). Remove cavity (4).

(*d*) Loosen nut (5) and remove bushing insulator (6), bearing housing (7), bushing insulator (8), bearing (9), and sleeve bushing (10).

(*e*) Unscrew shaft (11) and remove nut (5) from cavity (16).

(*f*) Remove electrical contact assembly (11) from tuned cavity (16) and remove electrical lead (13) from electrical contact assembly (15).

(*g*) Remove bearing (14) and separate electrical contact assembly (15) from cavity (16).

(4) *Disassembly of outer cavity* (fig. 5–20).

(*a*) Remove screw (17), washer (18), screw (22), and washer (23).

(*b*) Remove drive screws (19) and (24), bearing (21), actuators (20) and (25), and electrical contact assembly (26).

(*c*) Unsolder resistor (27) from electrical contact assembly (26).

(*d*) Remove bushing (28) and lockring (29). Loosen setscrew (30) and remove drive screw (31) and capacitor rotor (32).

(*e*) Unsolder the lead connected to RF coupling ring (36). Remove four screws (33) and washers (34) and remove capacitor retainer (35), RF coupling ring (36), and bushing insulator (37).

(*f*) Remove four screws (38) and washers (39) which secure cavity (40) to plate (42).

(*g*) Remove capacitor (43).

d. Assembly Procedures.

(1) *Assembly of outer cavity* (fig. 5–20).

(*a*) Mount capacitor (43) on plate (42).

(*b*) Mount cavity (40) on plate (42) with four screws (38) and washers (39).

(*c*) Assemble bushing insulator (37), RF coupling ring (36), capacitor retainer (35), and mount them on plate (42) with four screws (33) and washers (34).

(*d*) Solder the lead from capacitor (43) to RF coupling ring (36).

NOTE

In step (*e*) below coat the threads of capacitor rotor (32), setscrew (30), and bushing (28) with sealant before assembly.

(*e*) Insert lockring (29) and screw in drive screw (31). Connect capacitor rotor (32) to the drive screw, and adjust the space between the capacitor rotor and the cavity to 0.25 ± 0.03 inch, and tighten setscrew (30). Install bushing (28) and tighten to 220 ± 10 ounce-inches.

(*f*) Solder resistor (27) to electrical contact assembly (26).

(*g*) Insert electrical contact assembly (26) into cavity (40). Insert bearing (21) into rear plate (42). Screw drive screw (19) into actuator (20). Connect actuator (20) to electrical contact assembly (26) using screw (17) and washer (18).

(*h*) Turn drive screw (19) to seat it in bearing (21), and adjust the drive screw until the space between the actuator and rear plate (42) is 1.75 ± 0.005 inch.

(*i*) Install actuator (25) and drive screw (24) and connect the actuators to electrical contact assembly (26) with screw (22) and washer (23). Insure that electrical contact assembly (26) does not move.

(2) *Assembly of inner cavity* (fig. 5–20).

(*a*) Assemble bearing housing (7) and bushing insulators (6) and (8). Insert these items into the center plate (fig. 5–19, item 57). Insert bearing (9) into bearing housing (7).

(*b*) Place sleeve bushing (10) on shaft (11) and screw the shaft into electrical contact assembly (12).

(*c*) Insert tuned cavity (16) into electrical contact assembly (12) and screw nut (5) on to the tuned cavity.

(*d*) Insert shaft (11) into bearing (9) and screw tuned cavity (16) partially into bearing housing (7).

(*e*) Assemble electrical lead (13), electrical contact assembly (15) and bearing (14). Coat electrical contact assembly (15) with sealant and insert electrical lead (13) into shaft (11).

(*f*) Screw tuned cavity (16) into bearing housing (7) and screw electrical contact assembly (15) into the tuned cavity until the end play on shaft (11) is less than .002 inch, and tighten nut (5) against bushing insulator (8).

(*g*) Secure cavity (4) to the center plate (fig. 5–19, item 57) with four screws (45) and washers (46).

(*h*) Solder electrical contact (3) to RF cable (41) and to electrical contact assembly (15) so that item (3) does not bridge a slot of item (15).

(*i*) Insert insulator bushing (2) into cavity

(4) and screw electrical contact assembly (1) into the cavity.

(3) *Assembly of capacitor probe assembly* (fig. 5-19).

(*a*) Install bearings (76), (77), (85), (86) and (107) in mechanical housing (106).

(*b*) Insert shaft (82) into mechanical housing (106) and slide beveled gear (88), worm gear (87), collar (84), and helical gear (83) on to the shaft. Pin items (88), (87), (84) and (83) to shaft (82) with items (78), (79), (80), and (81).

(*c*) Insert shaft (71) into mechanical housing (106) and slide helical gear (75), beveled gear (74), four keyed washers (73) and collar (72) on to the shaft. Pin collar (72) to shaft (71) with item (70).

(*d*) Assemble sleeve (102), bearing (101), washer (100), helical gear (99), bushing (98), bearing (97), garter extension spring (96) and bushing insulator (104) on to probe holder (103).

(*e*) Insert capacitor probe (95) into probe holder (103) and solder the probe to the coaxial connector (part of probe holder).

(*f*) Secure cover (94) with two screws (93).

(*g*) Seat the capacitor probe assembly in mechanical housing (106), mesh helical gears (75) and (99) and pin item (75) to shaft (71) with item (69).

(*h*) Secure guide block (92) with two screws (89) and washers (90) and secure the capacitor probe assembly with two setscrews (91).

(*i*) Slide worm gear (109) on to drive screw (110). Seat the shaft in bearing (107) and mesh the worm gear with gear (87). Pin worm gear (109) to drive screw (110) with item (108).

(*j*) Secure the capacitor probe assembly mechanical housing (106) to the plate (fig. 5-20, item 42) with the three captive screws (105).

(4) *Assembly of rear and center plates* (fig. 5-19).

(*a*) Place woodruff key (66) on drive screw (110), slide spur gear (65) into place and secure it with setscrew (64).

(*b*) Insert washer (62), shim (67), and bearings (58), (68), and (68) into plate (57).

(*c*) Carefully and slowly bring the center and rear plates together, slide the inner cavities into the outer cavities and seat the three drive screws (110) (fig. 5-20, item 19) and shaft (71) in the center plate. Secure the outer cavities and the connector blocks (fig. 5-20, items 40 and 47) to the center plate using 14 screws (49) and washers (50).

(5) *Assembly of XMTR TUNE drive mechanism* (fig. 5-19).

(*a*) Install bearings (45), (46) and (48) in center plate (57).

(*b*) Pin spur gear (60) to shaft (61) with item (59) and seat the shaft in bearings (48) and (58).

(*c*) Slide beveled gear (47) on to shaft (61). Mesh spur gear (60) with spur gear (65) and pin gears (47) and (60) to shaft (61) with items (41) and (59).

(*d*) Secure two bushing insulators (5), terminal lugs (53) and washers (52) with screws (51).

(*e*) Slide shaft (42) into place and slide collar (44) and beveled gear (43) on to the shaft. Pin the collar and the beveled gear to the shaft with item (41).

(*f*) Mate flexible shaft (40) with shaft (42), secure channel-frequency indicator (38) to plate (57) with three screws (55) and washers (56). Pin shaft (40) to the indicator with item (39).

(*g*) Place two woodruff keys (37) on the drive screws (fig. 5-20, item 19), slide sprocket wheels (36) on to the drive screws and secure with setscrews (35).

(*h*) Place two woodruff keys (111) on to the drive screws (fig. 5-20, item 11), slide sprocket wheels (112) onto the drive screws and secure with setscrews (113).

(*i*) Place woodruff keys (34) and (31) on drive screw (110), slide sprocket wheel (33) and spur gear (30) into place and secure them with setscrews (32) and (29).

(*j*) Install roller chain (27) taking care not to rotate the sprocket wheels.

(*k*) Install bearing (22) in plate (57) and seat shaft (19) in the bearing. Secure spur gear (21) to the shaft with setscrew (20).

(*l*) Not used.

(*m*) Assemble headed shoulder pin (24), sprocket wheel (25), clutch disk (26), washer (2), and nut (1) on plate (5). Do not tighten nut (2).

(*n*) Seat bearings (6), (11), and (18) in plate (57). Seat bearings (9), (15), (23) and sleeve bushing (28) in plate (5).

(*o*) Pin spur gear (8) to shaft (10) with item (7) and seat the shaft in bearing (6).

(*p*) Pin spur gear (13) to shaft (14) with item (12) and seat the shaft in bearing (11).

(*q*) Pin spur (17) to shaft (71) with item (16).

(*r*) Carefully install plate (5) and secure it with three screws (3) and washers (4).

(*s*) Mesh sprocket wheel (25) with roller chain (27), tension the chain and tighten nut (1).

(*t*) Install electronic tubes V1 and V2 (fig. 5–20), and capacitors C5, C6, C12 and C13.

(*u*) Solder the leads to capacitors C5, C6, C12, C13 (fig. 5–19) and C7 and C14 (item 43, fig. 5–20). Remove the tags.

(*v*) Assemble the RF amplifier 37AR1AR1 as part of, RF amplifier 37AR1 (para 4–146), then test and align using the procedures given in paragraph 4–112.

e. Parts List for figure 5–19.

Item	Reference symbol	Description
1	37AR1AR1H1	Nut, self-locking hexagon
2	37AR1AR1H1	Washer, flat
3	37AR1AR1H3	Screw, machine
4	37AR1AR1H3	Washer, spring tension
5	37AR1AR1MP78	Plate, retaining bearing
6	37AR1AR1MP9	Bearing, ball, annular
7	37AR1AR1MP112	Pin, spring
8	37AR1AR1MP61	Gear, spur
9	37AR1AR1MP5	Bearing, ball, annular
10	37AR1AR1MP34	Shaft, shouldered
11	37AR1AR1MP11	Bearing, ball, annular
12	37AR1AR1MP113	Pin, spring
13	37AR1AR1MP38	Gear, spur
14	37AR1AR1MP85	Shaft, shouldered
15	37AR1AR1MP10	Bearing, ball, annular
16	37AR1AR1H7	Pin, spring
17	37AR1AR1MP39	Gear, spur
18	37AR1AR1MP12	Bearing, ball, annular
19	37AR1AR1MP86	Shaft, shouldered
20	37AR1AR1H2	Setscrew
21	37AR1AR1MP41	Gear, spur
22	37AR1AR1MP19	Bearing, ball, annular
23	37AR1AR1MP18	Bearing, ball, annular
24	37AR1AR1MP67	Pin, shoulder, headed
25	37AR1AR1MP62	Sprocket wheel
26	37AR1AR1MP29	Disk, clutch
27	37AR1AR1MP77	Chain, roller
28	37AR1AR1MP75	Bushing, sleeve
29	37AR1AR1H1	Setscrew
30	37AR1AR1MP47	Gear, spur
31	37AR1AR1MP107	Key, woodruff
32	37AR1AR1H1	Setscrew
33	37AR1AR1MP64	Sprocket wheel
34	37AR1AR1MP108	Key, woodruff
35	37AR1AR1H1	Setscrew
36	37AR1AR1MP65, MP66	Sprocket wheel
37	37AR1AR1MP103, MP104	Key, woodruff
38	37AR1AR1DS1	Indicator, channel-frequency.
39	37AR1AR1MP101	Pin, straight, headless
40	37AR1AR1MP28	Shaft, drive, flexible
41	37AR1AR1MP98, 99, 100	Pin, straight, headless
42	37AR1AR1MP89	Shaft, shouldered
43	37AR1AR1MP93	Gear, bevel
44	37AR1AR1MP88	Collar, shaft
45	37AR1AR1MP8	Bearing, ball, annular
46	37AR1AR1MP13	Bearing, ball, annular
47	37AR1AR1MP94	Gear, bevel
48	37AR1AR1MP15	Bearing, ball, annular
49	37AR1AR1H10	Screw, machine
50	37AR1AR1H10	Washer, spring, tension
51	37AR1AR1H1	Screw, machine
52	37AR1AR1H1	Washer, spring, tension
53	37AR1AR1E26, E27	Terminal, lug
54	37AR1AR1E22, E23	Insulator, bushing
55	37AR1AR1H3	Screw, machine
56	37AR1AR1H3	Washer, spring, tension
57	37AR1AR1MP33	Plate, electrical-mechanical.
58	37AR1AR1MP14	Bearing, ball, annular
59	37AR1AR1MP102	Pin, straight, headless
60	37AR1AR1MP37	Gear, spur
61	37AR1AR1MP36	Shaft, shouldered
62	37AR1AR1H1	Washer, spring, tension
63	37AR1AR1MP20	Bearing, ball, annular
64	37AR1AR1H1	Setscrew
65	37AR1AR1MP60	Gear, spur
66	37AR1AR1MP109	Key, woodruff
67	37AR1AR1MP122	Shim
68	37AR1AR1MP1, MP4	Bearing, ball, annular
69	37AR1AR1MP111	Pin, spring
70	37AR1AR1MP118	Pin, spring
71	37AR1AR1MP42	Shaft, shouldered
72	37AR1AR1MP35	Collar, shaft
73	37AR1AR1H4	Washer, key
74	37AR1AR1MP63	Gear, bevel
75	37AR1AR1MP46	Gear, helical
76	37AR1AR1MP3	Bearing, ball, annular
77	37AR1AR1MP17	Bearing, ball, annular
78	37AR1AR1MP119	Pin, spring
79	37AR1AR1MP116	Pin, spring
80	37AR1AR1MP117	Pin, spring
81	37AR1AR1MP110	Pin, spring
82	37AR1AR1MP87	Shaft, shouldered
83	37AR1AR1MP45	Gear, helical
84	37AR1AR1MP90	Collar, shaft
85	37AR1AR1MP16	Bearing, ball, annular
86	37AR1AR1MP21	Bearing, ball, annular
87	37AR1AR1MP48	Gear, worm wheel
88	37AR1AR1MP95	Gear, bevel
89	37AR1AR1H4	Screw, machine
90	37AR1AR1H4	Washer, spring, tension
91	37AR1AR1H4	Setscrew
92	37AR1AR1MP58, MP59	Block, guide
93	37AR1AR1C2H2, C9H2	Screw, machine
94	37AR1AR1C2MP5, C9MP5	Cover, variable, capacitor.
95	37AR1AR1C2E2, C9E2	Probe, capacitor
96	38AR1AR1MP22, MP23	Spring, garter, extension
97	37AR1AR1C2MP2, C9MP2	Bearing, ball, annular
98	37AR1AR1C2MP8, C9MP8	Bushing, bearing
99	37AR1AR1C2MP3, C9MP3	Gear, helical
100	37AR1AR1C2H1, C9H1	Washer, spring tension
101	37AR1AR1C2MP1, C9MP1	Bearing, ball, annular

Item	Reference symbol	Description
102	37AR1AR1C2MP7, C9MP7	Bearing, sleeve
103	37AR1AR1C2MP4, C9MP4	Holder, probe
104	37AR1AR1C2E1, C9E1	Insulator, bushing
105	37AR1AR1H3	Screw, machine
106	37AR1AR1MP72	Housing, mechanical drive.
107	37AR1AR1MP2	Bearing, ball, annular
108	37AR1AR1MP115	Pin, spring
109	37AR1AR1MP49	Gear, worm
110	37AR1AR1MP40	Screw, drive
111	37AR1AR1MP105, MP106	Key, woodruff
112	37AR1AR1MP91, MP92	Sprocket wheel
113	37AR1AR1H1	Setscrew

f. Parts List for figure 5–20.

Item	Reference symbol	Description
1	37AR1AR1E24	Contact assembly, electrical
	37AR1AR1E25	Contact assembly, electrical
2	37AR1AR1E13	Insulator, bushing
	37AR1AR1E14	Insulator, bushing
3	37AR1AR1E5	Contact, electrical
	37AR1AR1E16	Contact, electrical
4	37AR1AR1Z1	Cavity, tuned
	37AR1AR1Z1	Cavity, tuned
5	37AR1AR1H2	Nut, plain, hexagon
6	37AR1AR1E7	Insulator, bushing
	37AR1AR1E9	Insulator, bushing
7	37AR1AR1MP70	Housing, bearing
	37AR1AR1MP71	Housing, bearing
8	37AR1AR1E8	Insulator, bushing
	37AR1AR1E10	Insulator, bushing
9	37AR1AR1MP24	Bearing, ball, annular
	37AR1AR1MP25	Bearing, ball, annular
10	37AR1AR1MP73	Bushing, sleeve
	37AR1AR1MP74	Bushing, sleeve
11	37AR1AR1MP50	Shaft, shouldered
	37AR1AR1MP51	Shaft, shouldered
12	37AR1AR1E15	Contact assembly, electrical
	37AR1AR1E16	Contact assembly, electrical
13	37AR1AR1E11E1	Lead, electrical
	37AR1AR1E12E1	Lead, electrical
14	37AR1AR1MP26	Bearing, ball, annular
	37AR1AR1MP27	Bearing, ball, annular
15	37AR1AR1E11	Contact assembly, electrical
	37AR1AR1E12	Contact assembly, electrical
16	37AR1AR1Z3	Cavity, tuned
	37AR1AR1Z4	Cavity, tuned
17	37AR1AR1H2	Screw, shouldered
18	37AR1AR1H2	Washer, spring tension
19	37AR1AR1MP43	Screw, drive
	37AR1AR1MP44	Screw, drive
20	37AR1AR1MP79	Actuator, mechanical-linear.
	37AR1AR1MP80	Actuator, mechanical-linear.
21	37AR1AR1MP6	Bearing, ball, annular
	37AR1AR1MP7	Bearing, ball, annular
22	37AR1AR1H2	Screw, shoulder
23	37AR1AR1H2	Washer, spring tension
24	37AR1AR1MP40	Screw, drive
25	37AR1AR1MP76	Actuator, mechanical-linear.
26	37AR1AR1E1	Contact assembly, electrical
	37AR1AR1E2	Contact assembly, electrical.
27	37AR1AR1E1R1	Resistor, fixed, composition.
	37AR1AR1E1R2	Resistor, fixed, composition.
28	37AR1AR1MP81	Bushing, machine thread
	37AR1AR1MP82	Bushing, machine thread
29	37AR1AR1MP68	Ring, lock
	37AR1AR1MP69	Ring, lock
30	37AR1AR1H1	Setscrew
31	37AR1AR1MP83	Screw, drive
	37AR1AR1MP84	Screw, drive
32	37AR1AR1E17	Rotor, capacitor
	37AR1AR1E18	Rotor, capacitor
33	37AR1AR1H8	Screw, machine
34	37AR1AR1H8	Washer, spring, tension
35	37AR1AR1MP55	Retainer, capacitor
	37AR1AR1MP56	Retainer, capacitor
36	37AR1AR1C1	Coupling ring, RF
	37AR1AR1C3	Coupling ring, RF
37	37AR1AR1E20	Insulator, bushing
	37AR1AR1E21	Insulator, bushing
38	37AR1AR1H8	Screw, machine
39	37AR1AR1H8	Washer, spring, tension
40	37AR1AR1Z5	Cavity, tuned
	37AR1AR1Z6	Cavity, tuned
41	37AR1AR1W2	Cable, RF
	37AR1AR1W3	Cable, RF
42	37AR1AR1MP32	Plate, electrical-mechanical.
43	37AR1AR1C7	Capacitor, fixed, ceramic dielectric.
	37AR1AR1C14	Capacitor, fixed, ceramic dielectric.
44	Not used	
45	37AR1AR1H4	Screw, machine
46	37AR1AR1H4	Washer, spring, tension
47	37AR1AR1MP96	Block, retaining, electrical connector.
	37AR1AR1MP97	Block, retaining, electrical connector.

5–24. Disassembly and Assembly of Channel-Frequency Indicator 37AR1AR1DS1 (fig. 5–21)

a. Disassembly.

(1) Remove the tape retainer mounting screws and then remove the tape retainer.

(2) Remove the spool retaining rings and then remove the spools with the channel-frequency tape.

(3) Remove the tuning shaft retaining ring and remove the tuning shaft and sprocket wheel.

(4) Pull the channel-frequency tape free of the spools.

b. Assembly.

(1) Uncoil one end of the channel-frequency tape and place it over a spool and allow the tape to coil over the spool.

(2) Install a spool on the other end of the tape in a similar manner.

(3) Install the sprocket wheel and the tuning shaft and secure it with the retaining ring.

(4) Mesh the sprocket wheel with the tape perforations and fit the tape into the tape guide.

(5) Install the second spool and secure both spools in position with the retaining rings.

(6) Place the tape retainer in position and secure it with the two mounting screws.

5–25. Disassembly and Assembly of Control-Indicators 37A2 and 33A4

a. General.

(1) This paragraph describes the disassembly and assembly of control-indicators 37A2 and 33A4, which are used for channel selection in the band II transmitter and receiver RF heads.

(2) Both control-indicators provide the same binary code, however, the receiver control-indicator (33A4) is offset by 60 channels which results in a local oscillator frequency which is 30 MHz higher than the received frequency. For example, when 37A2 is set to channel 624 and 33A4 is set to 564, the two binary codes are identical.

(3) Use a soldering iron to soften the sealing compound on setscrews.

(4) Before punching out, or pressing in pins, support the items being unpinned or pinned.

b. Special Tools.

1/16-inch driftpin punch

No. 52 Waldes Truarc retaining ring pliers

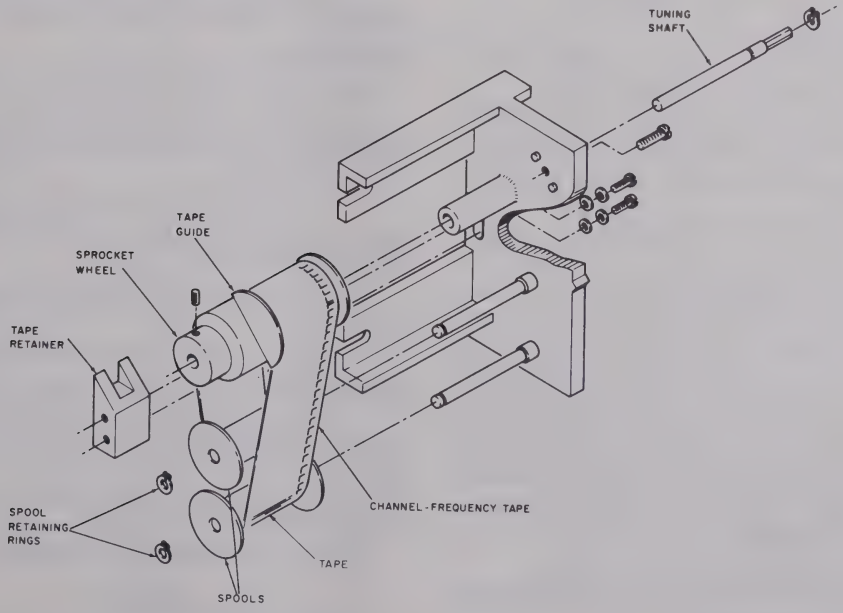


Figure 5–21. Channel-frequency indicator 37AR1AR1DS1 or 33AR1AR1DS1, exploded view.

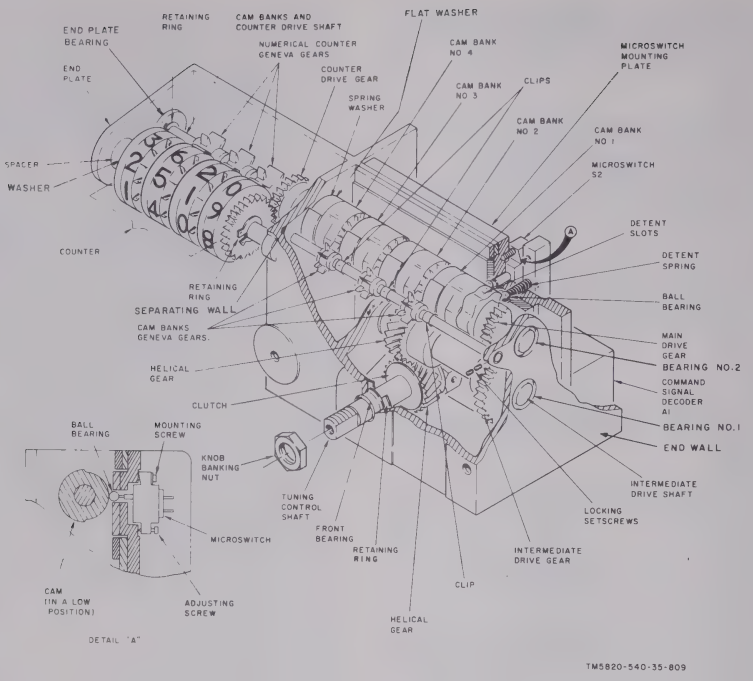


Figure 5–22. Control-indicator, band II or III, cutaway view.

c. Disassembly procedures (fig. 5–22).

(1) *General.*

(*a*) Remove the four mounting screws which secure the cover and remove the cover.

(*b*) If the fault is not known the assembly should be carefully examined before disassembly.

(2) *Removal of microswitches and command signal decoder.*

(*a*) Remove the clip securing the wiring harness to the chassis.

(*b*) Remove the two screws securing the command signal decoder; slide the decoder away from the microswitches to expose three screws.

(*c*) Remove the five screws securing the microswitch mounting plate, hold the plate in place, turn the assembly over, and with the decoder terminals facing downward, carefully lift the chassis clear of the microswitch mounting plate. Remove the 12 ball bearings and the detent spring for safekeeping.

(3) *Removal of counter wheels.*

(*a*) Slide the retaining ring away from the "units" counter.

(*b*) Slide the shaft out of its seating and remove the retaining ring.

(*c*) Remove the counter wheels, the washer, and spacer by sliding the shaft through the end plate.

(4) *Removal of cam bank Geneva gears.*

(*a*) Soften the Loctitie and remove the first locking setscrew. Loosen the second setscrew securing the shaft.

(*b*) Remove the three cam bank Geneva gears and the three clips by sliding the shaft through the end wall.

(5) *Removal of cam banks and counter drive shaft.*

(*a*) Remove the pins from the main drive gear, cam bank No. 1, and the counter drive gear.

(*b*) Slide the shaft through the end wall and remove the retaining ring, the three numerical counter Geneva gears, the counter drive gear, the spring washer, the flat washer, the four cam banks, and the main drive gear.

(6) *Removal of tuning control shaft.*

CAUTION

The slipping clitch is preset and should not be disturbed.

(*a*) Remove the knob banking nut and the retaining ring.

(*b*) Push the front bearing out of its seat.

(*c*) Pull the shaft forward to unseat the far end, tilt the shaft and remove it through the bottom opening of the casting.

(7) *Removal of intermediate drive shaft.* Remove the pins securing the intermediate drive gear and the helical gear to the shaft. Slide the shaft out through end wall bearing No. 1.

d. Assembly Procedures (fig. 5-22).

(1) *Assembly of cam banks and counter drive shaft.*

(*a*) Slide the shaft through bearing No. 2 and slide the main drive gear on to the shaft.

(*b*) Slide the cam banks on to the shaft in the following order:

1. Cam bank No. 1 (with pinhole).

2. Cam banks No. 2 and 3 (identical).

3. Cam bank No. 4 (shortest cam bank).

(*c*) Slide the flat washer and the spring washer on to the shaft and push the shaft through the bearing in the separating wall.

(*d*) Slide the counter drive gear and Geneva gears on to the shaft. Insure that the Geneva gear half-teeth are away from the counter drive gear.

(*e*) Slide the retaining ring on to the shaft and press the shaft into the end plate bearing. Slide the retaining ring up against the bearing.

(*f*) Pin the main drive gear and cam bank No. 1. If the original counter drive gear has been replaced, pin it. If a new counter drive gear has been used it will be pinned during assembly of the counter wheels.

(2) *Assembly of microswitches and command signal decoder.*

(*a*) With the decoder terminals and switches facing downward, insert the detent spring and the 12 ball bearings.

(*b*) Carefully fit the decoder-microswitch assembly to the chassis and secure it with the five screws.

(*c*) Slide the command signal decoder in to position and secure it with the two screws.

(*d*) Secure the wiring harness to the chassis.

(3) *Assembly of numerical counter.*

(*a*) Rotate cam bank No. 1 until all three cams are in their lowest position.

NOTES

1. Cam Bank No. 1, and the shaft, should remain in this position until assembly of the counter is completed.
2. A cam low position corresponds to a microswitch in the relaxed position.

(*b*) Slide the shouldered end of the counter shaft through the hole in the end plate and slide the spacer and washer on to the shaft.

(*c*) Fit the "thousands" counter on to the shaft with the blank position (37A2 and 33A4) to the front and mesh it with a Geneva gear half-tooth.

(*d*) Fit the "hundreds" counter on to the shaft with the numeral 6 (37A2) or 5 (33A4) to the front and mesh it with a Geneva gear half-tooth.

NOTE

The "hundreds" counter has stops fitted between numerals 5 and 6, 7 and 8.

(*e*) Fit the "tens" counter on to the shaft with the numeral 2 (37A2) or 6 (33A4) to the front and mesh it with a Geneva gear half-tooth.

(*f*) Position the "units" counter with the numeral 4 (37A2 and 33A4) to the front and slide the shaft through the wheel.

(*g*) Fit the retaining ring on to the shaft, push the shaft home and slide the retaining ring up against the "units" gear.

(*h*) Check that the numerals 624 (37A2) or 564 (33A4) are displayed to the front.

(*i*) The following applies only if a new counter drive gear is being used:

1. Mesh the counter drive gear with the "units" counter and lock it in this position with the setscrew.

2. Drill through the pinhole and press in a pin. Remove the setscrew.

(4) *Assembly of intermediate drive shaft.*

(a) Slide the shouldered end of the intermediate drive shaft through bearing No. 1.

(*b*) Slide the intermediate drive gear and the helical gear on to the shaft.

(*c*) Slide the shaft home and mesh the intermediate drive gear with the main drive gear.

(*d*) If the original helical gear has been replaced, pin both gears. If a new helical gear has been used, pin the intermediate drive gear.

(*e*) If a new helical gear has been used, assemble the tuning control shaft ((5) below), and lock the helical gear in position with the setscrew.

(*f*) Remove the tuning control shaft (*c*(6)

above), drill through the helical gear pinhole and press in a pin. Remove the helical gear setscrew.

(5) *Assembly of tuning control shaft.*

NOTE

The helical gear and clutch assembly, and the front dearing, should be on the shaft.

(*a*) Insert the threaded end of the shaft in the front bearing hole through the bottom opening of the casting. Mesh the two helical gears and seat the shaft in the rear bearing.

(*b*) Seat the front bearing and fit the retaining ring in to groove in the shaft.

(*c*) Screw the knob banking nut on to the shaft.

(6) *Assembly of cam bank Geneva gears.*

(*a*) Rotate cam banks No. 2 and 3 until all cams are in a low position. Rotate cam bank No. 4 until the S11 cam is in a low position and the S12 cam is in a high position.

NOTE

The counter should be at 624 (37A2) or 564 (33A4); cam bank No. 1 cams should be in low positions ((3)(*a*) above).

(*b*) With the cam banks positioned as above, slide the Geneva gear shaft through the casting and slide the Geneva gears and clips onto the shaft. Insure that the Geneva gear half-teeth are toward the counter.

(*c*) Carefully mesh the Geneva gears with the cam bank gears and slide the shaft home. Tighten the shaft securing setscrew.

(*d*) Check the mechanical assembly of the control-indicator as follows:

1. Change the counter display from 624 to 623 (37A2) or 564 to 563 (33A4) while observing the cams. The cams for S2 to S11 should go to high positions and the cam for S12 should go to a low position.

2. Change the counter display from 623 to 624 (37A2) or 563 to 564 (33A4) while observing the cams. The cams for S2 to S11 should go to low positions and the cam for S12 should go to a high position.

(*e*) Install the second setscrew to lock the setscrew securing the Geneva gear shaft.

(*f*) Apply Loctite to all setscrews.

(*g*) Replace the cover.

(*h*) Test the control-indicator using the procedure given in paragraph 4–111.

5–26. Replacement and Alignment of Duplexer Subassembly 33A1A1

a. General. This paragraph contains the replacement and alignment procedures for duplexer subassembly 33A1A1. Use the test procedures in paragraph 4–120 to determine whether the receiver or transmitter filter, or both filters, require adjustment. Due to the length and complexity of the alignment procedures the subassembly should be retested after alignment, using the procedures in paagraph 4–120.

b. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Receiver TS–2867(V)1/GRM–95(V).	Receiver test facility
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/ GRM–95(V).	Accessory kit
Generator, Signal SG–409( )/U.	Signal generator No. 1
Generator, Signal SG–340A/G	Signal generator No. 2.
Generator, Signal AN/ USM–205.	Wide range oscillator
Generator, Sweep SG–888	Sweep generator
Oscilloscope AN/USM–281	Oscilloscope
Frequency Meter AN/ USM–159.	Frequency meter
Filter, low pass TLC–1000–5EF.	Filter TLC–1000–5EF
Termination, Shorting Omni Spectra 20140.	Shorting termination
50-ohm Load Omni Spectra 20020P (2 required).	50-ohm load OS20020P
Detector RF XD–23A	Detector XD–23A
Adapter-Connector Omni Spectra 21020.	Adapter-connector OS21020

c. Special Tools.

SM–B–696036 ——— Short circuit tool
SM–B–696037 ——— Short circuit tool (2 required)
SM–D–696038 ——— Coupling probe
SM–D–696040 ——— Coupling probe

d. Replacement Procedures.

(1) *Disassembly* (figs. 4–227 and 5–23).

(*a*) Remove amplifier-converter cover 33MP1 by following the procedure given in TM 11–5820–540–12.

(*b*) Remove control-indicator 33A4 by following the procedure given in TM 11–5820–540–12.

(*c*) Remove power supply 33PS1 by following the procedure given in TM 11–5820–540–12.

(*d*) Remove signal distribution panel 33A6 (para 4–147).

(*e*) Remove intermediate frequency amplifier 33AR1 (para 3-96).

(*f*) Remove frequency mixer stage 33A7 (para 3-97).

(*g*) Remove signal level control-monitor 33A5 (para 3-95).

(*h*) Remove speed decreaser gear assembly 33A1MP1 (para 4-151).

(*i*) Remove frequency multiplier group 33A2 (para 4-152).

(*j*) Remove radio frequency power monitor 33A3 (para 4-149).

(*k*) Remove voltage control assembly 33A1A2 (para 4-155).

(*l*) Not used.

(*m*) Disconnect 33W5P2 from J1 of low-pass filter 33FL1 and remove the screws securing 33A1W1J8, 33A1W1J9 and the bottom support.

(*n*) Raise the bottom support and feed 33A1W1J8 and 33A1W1J9 through the holes in the bottom support.

(*o*) Remove the screws securing terminal board 33A1W1TB1 and wiring harness to the bottom support.

(*p*) Remove the screws securing 33A1W1J3, 33A1W1J6 and 33W7J1.

(*q*) Loosen connector 33A1W1A1J2 sleeve nut and slide it down the radio frequency cable; remove the screws securing 33A1W1A1J2 and move it clear of the chassis.

(*r*) Remove the hardware securing the wiring harness to the electrical equipment chassis and duplexer subassembly.

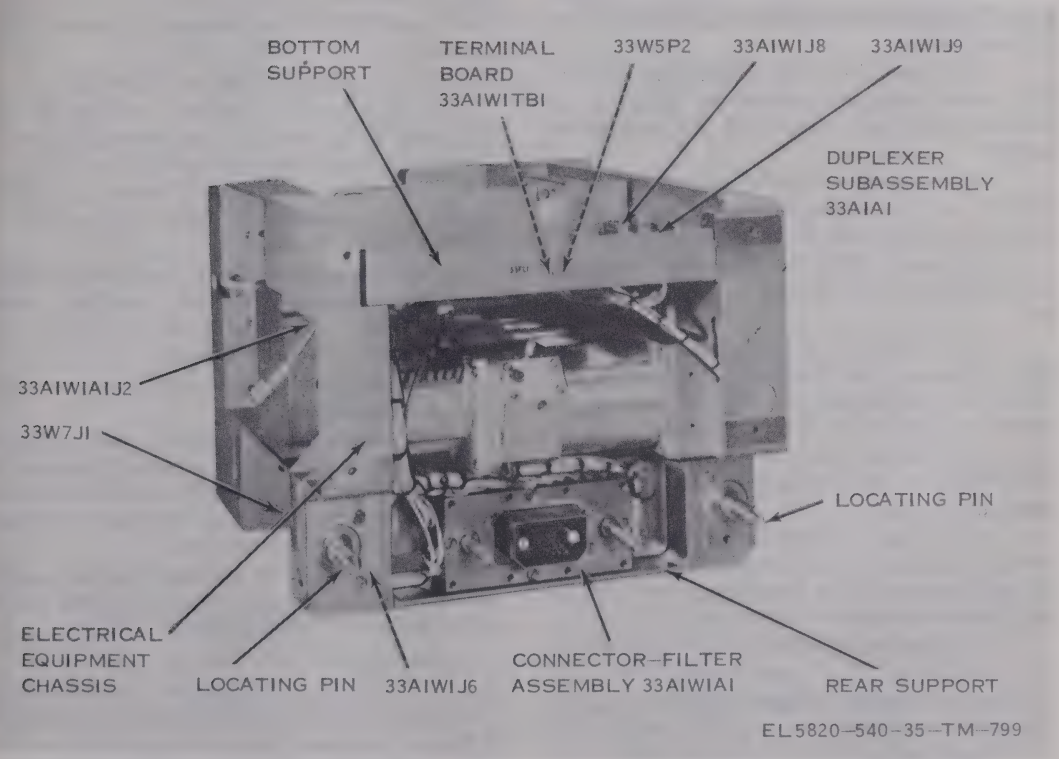


Figure 5-23. Band II receiver RF head partially disassembled, top and rear view.

(*s*) Remove the locating pins and screws securing the rear support. Note number of shims.

(*t*) Remove screws securing the electrical equipment chassis; remove the chassis and the six cavity positioning rings.

(*u*) Remove the remaining screws securing the wiring harness to the duplexer subassembly.

(*v*) Remove the screws securing 33A1W1J4 and screws and the spacers securing 33A1W1J5 and 33A1W1J7. Remove the wiring harness complete with connector-filter assembly 33A1W1A1 and the rear support.

(2) *Reassembly* (figs. 4–227 and 5–23).

(*a*) Place the wiring harness, complete with filter-connector assembly 33A1W1A1 and the rear support, in position. Secure the wiring harness to the duplexer subassembly with the appropriate hardware.

(*b*) Secure 33A1W1J4, 33A1W1J5, and 33A1W1J7 with the appropriate hardware.

(*c*) Fit the cavity positioning rings to the cavity caps, place the electrical equipment chassis in position and secure it with the three screws at the front edge.

(*d*) Orient the cavity positioning rings to align screw holes and secure the rings to the electrical equipment chassis with the appropriate hardware.

(*e*) Secure 33A1W1J3, 33A1W1J6, 33W7J1, and the wiring harness to the electrical equipment chassis with the appropriate hardware.

(*f*) Secure 33A1W1A1J2 with the appropriate hardware and tighten the connector sleeve nut.

(*g*) Install the locating pins but do not tighten the nuts. Slide the shims into position and secure the rear support with the appropriate hardware. Tighten the locating pin nuts.

(*h*) Secure the wiring harness and 33A1W1TB1 to the bottom support with the appropriate hardware.

(*i*) Feed 33A1W1J8 and 33A1W1J9 through the holes in the bottom support. Secure the connectors and the bottom support with the appropriate hardware.

(*j*) Connect 33W5P2 to J1 of low-pass filter 33FL1.

(*k*) Replace voltage control assembly 33A1A2 (para 4–155).

(*l*) Not used.

(*m*) Replace radio frequency power monitor 33A3 (para 4–149).

(*n*) Replace frequency multiplier group 33A2 (para 4–152).

(*o*) Replace speed decreaser gear assembly 33A1MP1 (para 4–151).

(*p*) Replace signal level control-monitor 33A5 (para 3–95).

(*q*) Replace frequency mixer stage 33A7 (para 3–97).

(*r*) Replace intermediate frequency amplifier 33AR1 (para 3–96).

(*s*) Replace power supply 33PS1 by following the procedure given in TM 11–5820–540–12.

(*t*) Replace signal distribution panel 33A6 (para 4–147).

(*u*) Replace control-indicator 33A4 by following the procedure given in TM 11–5820–540–12.

(*v*) Replace amplifer-connector cover 33MP1 by following the procedure given in TM 11–5820–540–12.

(*w*) Align amplifier-converter unit 33 (para 4–118 *d*).

e. Transmitter Filter Electrical Alignment Procedures.

(1) *Test setup calibration* (fig. 5–24).

(*a*) Remove covers from cavities Z6 and Z7. Unscrew S1, reverse it and screw it in until it just short circuits the center conductor of Z1.

(*b*) Turn XMTR DUPL control to XMTR CHANNEL 1000 and RCVR SIG control to RCVR CHANNEL 400.

(*c*) Insert short circuit tool SM-B-696036 into Z6. Carefully insert coupling probe SM-D-696038 into Z7 with the tool probe adjusted to clear the cavity plunger.

(*d*) Connect the test equipment as shown in A, figure 5–25.

(*e*) Turn sweep generator attenuators to 35 db. Turn signal generator output frequency to 700 MHz, measured on the frequency meter, and adjust output level for a suitable marker amplitude, viewed on the oscilloscope.

(*f*) Using sweep generator markers, adjust sweep width to display sweep from 696 to 704 MHz. Switch off sweep generator markers.

(2) *Cavity Q.*

(*a*) Connect test equipment as shown in B, figure 5–25. Turn sweep generator attenuators to 0 db.

(*b*) Adjust depth of coupling probe to display a single-peaked response centered on the 700-MHz marker.

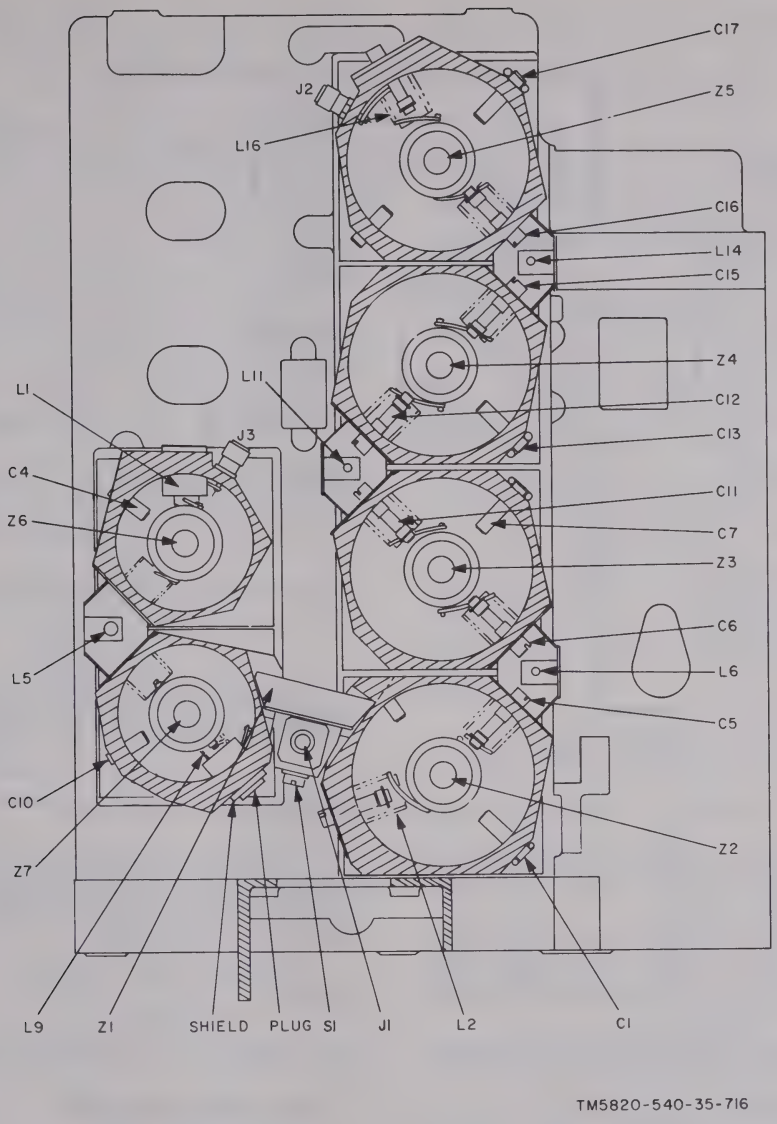


Figure 5–24. Duplexer subassembly 33A1A1 parts location.

(*c*) Connect test equipment as shown in C, figure 5–25.

(*d*) Adjust wide range oscillator (wro) output frequency and level, to position markers halfway between top and bottom of response.

(*e*) Multiply wro frequency, as displayed on counter, by 2 to obtain unloaded bandwidth. Note unloaded bandwidth.

(*f*) Unscrew S1, reverse it and replace it in the normal operating position.

(*g*) Repeat steps (*b*) and (*d*) above.

(*h*) Multiply wro frequency, as displayed on counter, by 2 to obtain loaded bandwidth. Note loaded bandwidth.

(*i*) Subtract unloaded bandwidth from loaded bandwidth. The remainder should be 4.10

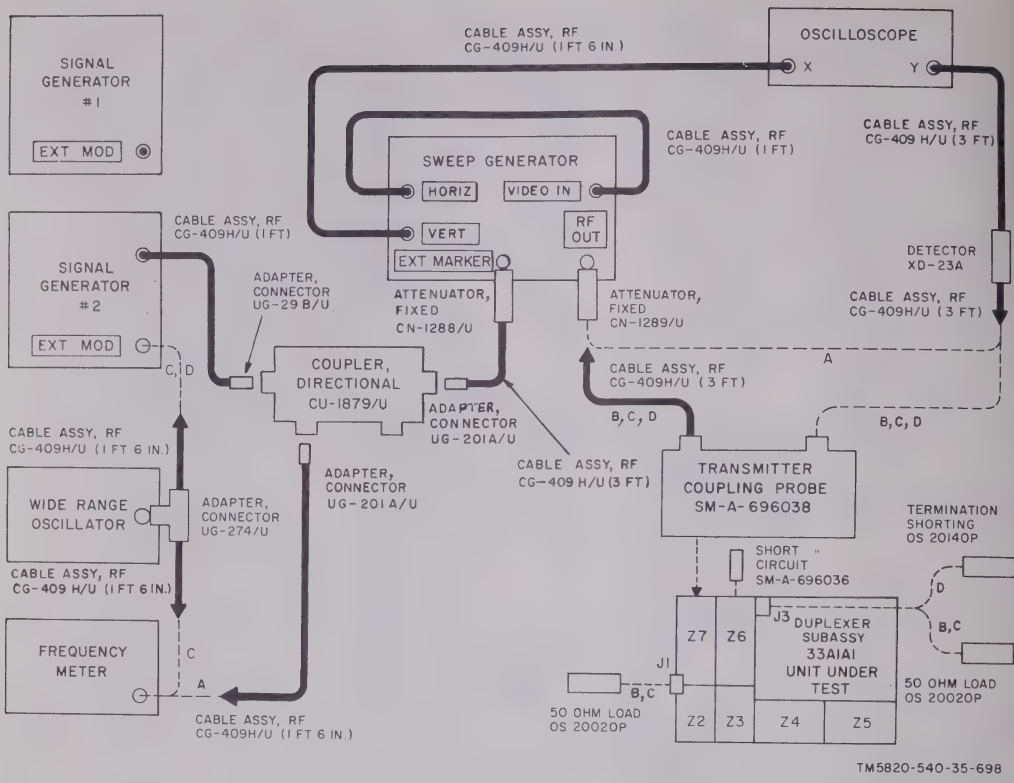


Figure 5–25. Duplexer subassembly 33A1A1 transmitter filter alignment setup.

± .05 MHz. If correct remainder is obtained, proceed with step (*m*) below, otherwise adjust as follows ((*j*) and (*k*) below).

(*j*) Loosen setscrew securing shield of L9. Loosen plug (ccw) and push shield inward. Turn plug clockwise while pressing inward until bandwidth is suitably adjusted.

(*k*) Reverse S1 to short circuit Z1 and repeat steps (*b*) and (*d*) to (*i*).

(*l*) Not used.

(*m*) Remove SM-B-696036 and SM-D-696038. Insert SM-B-696036 in to Z7. Carefully insert SM-A-696038 in to Z6 with probe adjusted to clear cavity plunger.

(*n*) Reverse S1 to short circuit Z1.

(*o*) Repeat steps (*b*) and (*d*) to (*h*) above.

(*p*) Subtract unloaded bandwidth from loaded bandwidth. The remainder should be 4.00 ± .05 MHz. If correct remainder is obtained proceed with coupling bandwidth tests; otherwise adjust L1 as follows:

(*q*) Loosen setscrew securing shield of L1. Loosen plug (ccw) and push shield inward. Turn plug clockwise while pressing inward until bandwidth is suitably adjusted.

(*r*) Retest as per steps (*b*), (*d*) to (*h*) and (*p*) above.

(*s*) Remove load from J3 and SM-B-696036 and SM-D-696038 from Z7 and Z6.

(3) *Coupling bandwidth.*

(*a*) Remove cover from Z2. Insert SM-B-696036 into Z2 and carefully insert SM-D-696038 into Z7. Connect shorting termination OS20140P to J3 (D, fig. 5–25).

(*b*) Connect the RF output of the sweep generator to the vertical input of the oscilloscope as shown in A, figure 5–25.

(*c*) Turn sweep generator attenuators to 35 db and adjust sweep to display from 690 to 710 MHz.

(*d*) Reconnect SM-D-696038 (D, fig. 5–25). Turn sweep generator attenuators to 0 db.

(*e*) Reverse S1 to short circuit Z1. Insure that RCVR CHANNEL is at least 100 channels away from XMTR CHANNEL (1000).

(*f*) Obtain a double peaked response with equal amplitude peaks, centered on 700-MHz marker, by adjusting coupling probe depth and C10. Typical response is shown in figure 5–26.

(*g*) Adjust wro to place markers on peaks. Multiply wro frequency, as displayed on counter, by 2. Product should be 4.00 ± .05 MHz.

(*h*) If correct bandwidth is not obtained, adjust L5 and repeat step (*g*) above.

(*i*) Remove SM-**B**-696036, SM-**D**-696038 and shorting termination. Replace cavity covers.

(4) *Filter tracking and vswr.*

(*a*) Connect test equipment as shown in A, figure 5–27.

(*b*) Turn sweep generator output attenuator to 0 db and sweep width to maximum. Insure that sweep generator is level from 390 to 710 MHz.

(*c*) Mark oscilloscope response as 1.5:1 vswr.

NOTE

Do not readjust oscilloscope vertical gain or positioning controls during the following tests.

(*d*) Connect test equipment as shown in B, figure 5–27.

(*e*) With reference to chart below, turn XMTR DUPL control clockwise to XMTR CHANNEL 1010, RCVR SIG control to RCVR CHANNEL 390 and signal generator output frequency to 705 MHz, measured on the counter.

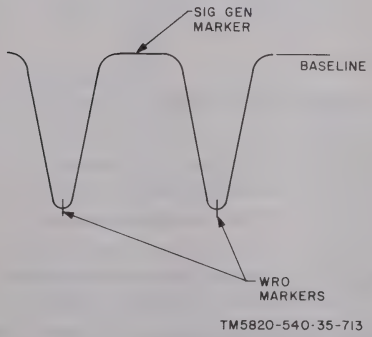


Figure 5–26. Duplexer subassembly 33A1A1 typical coupling response curve.

(*f*) Adjust signal generator output level for a suitable marker amplitude, viewed on the oscilloscope.

(*g*) Adjust C4 and C10 for a symmetrical response centered on the 705-MHz marker. Vswr at 705 MHz should be less than 1.5:1.

(*h*) Connect test equipment as shown in C, figure 5–27.

(*i*) Adjust wro to place markers at points where response intersects 1.5:1 vswr line, as shown in figure 5–28. Note wro frequency, as indicated on counter.

(*j*) Multiply wro frequency, noted in step (*i*) above by 2 to obtain bandwidth. Bandwidth should be greater than 2.0 MHz.

(*k*) If bandwidth is out of tolerance repeat steps (*g*), (*i*) and (*j*) above.

(*l*) Not used.

(*m*) Repeat steps (*d*) to (*j*) above for the channel numbers and frequencies given below. If bandwidth is out of tolerance then adjust equally, on both cavities, the screws indicated. After any adjustment repeat tests at previous higher frequency.

XMTR CHANNEL	Sig gen freq. (MHz)	RCVR CHANNEL	Tuning screws (fig. 5–29)
1010	705	390	C4, C10
930	665	390	B
790	595	390	C
690	545	390	D
610	505	390	E
540	470	390	F
480	440	1010	G
440	420	1010	H
390	395	1010	J

(*n*) Turn XMTR DUPL control to XMTR CHANNEL 1010. Remove covers from Z6 and Z7.

(*o*) Carefully insert SM-**B**-696036 into Z6 and Z7, in turn, and insure that it neither fouls, nor is obstructed by, any of the tuning screws. If SM-**B**-696036 cannot be fully inserted into either cavity, then adjust obstructing screw and repeat step (*m*) above.

(*p*) Replace covers of Z6 and Z7.

f. Receiver Filter Electrical Alignment Procedures.

(1) *Test setup calibration.*

(*a*) Remove covers from cavities Z2 through Z7. Unscrew S1, reverse and screw it in

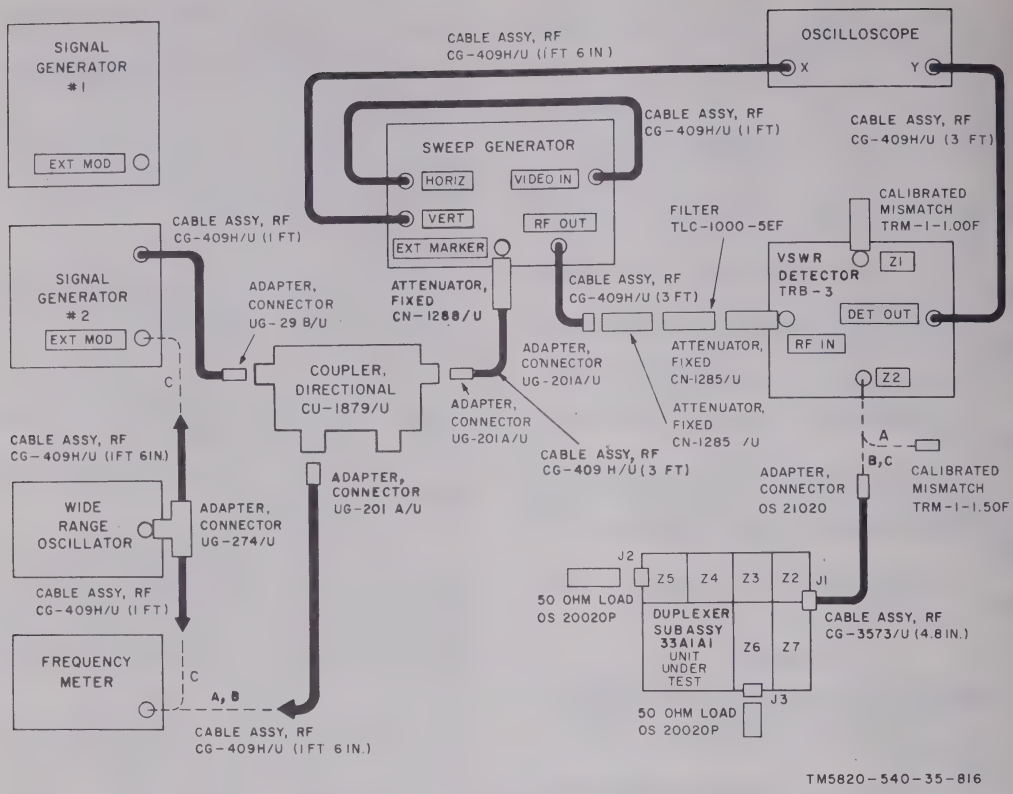


Figure 5-27. Duplexer subassembly 33A1A1, tracking and vswr test setup.

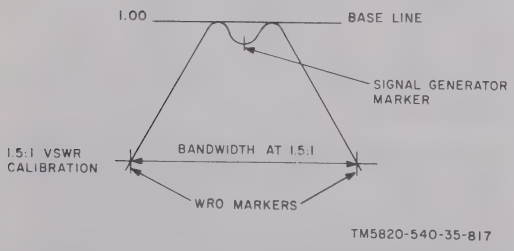


Figure 5-28. Duplexer subassembly 33A1A1, typical vswr response curve.

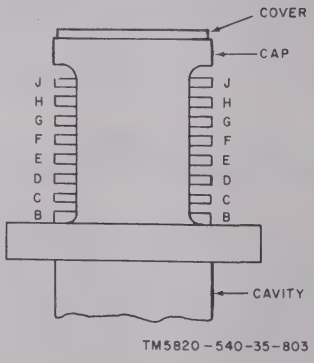


Figure 5-29. Duplexer subassembly 33A1A1, identification cap tuning screws.

until it just short circuits the center conductor of Z1.

(*b*) Turn RCVR SIG control RCVR CHANNEL 800 and XMTR DUPL control to XMTR CHANNEL 400.

(*c*) Insert the two short circuit tools SM-B-696037 into Z3 and Z4, and short circuit tool SM-B-696036 into Z7. Carefully insert coupling probe SM-D-696040 into Z2 with probe adjusted to clear cavity plunger.

(*d*) Connect test equipment as shown in A, figure 5-30.

(*e*) Turn sweep generator attenuators to 35 db. Turn signal generator output frequency to 600 MHz, measured on the frequency meter, and adjust output level for a suitable marker amplitude, viewed on the oscilloscope.

(*f*) Using sweep generator markers, adjust sweep width to display from 598 to 602 MHz.

(2) *Cavity Q.*

(*a*) Connect test equipment as shown in B, figure 5–30. Turn sweep generator attenuators to 0 db.

(*b*) Adjust depth of coupling probe to display a single-peaked response centered on the 600-MHz marker.

(*c*) Connect test equipment as shown in C, figure 5–30.

(*d*) Adjust wro output frequency and level to position markers halfway between top and bottom of response.

(*e*) Multiply wro frequency, as displayed on counter, by 2 to obtain unloaded bandwidth. Note unloaded bandwidth.

(*f*) Unscrew S1, reverse it and replace it in the normal operating position.

(*g*) Repeat steps (*b*) and (*d*) above.

(*h*) Multiply wro frequency, as displayed on counter, by 2 to obtain loaded bandwidth. Note loaded bandwidth.

(*i*) Subtract unloaded bandwidth from loaded bandwidth. The remainder should be 4.80 ± .05 MHz.

(*j*) If correct remainder is obtained proceed with step (*m*) above, otherwise adjust as follows in (*k*) through (*o*) below.

(*k*) Remove cover from L2 and turn core of L2 to adjust bandwidth. Reverse S1 to short circuit Z1 and repeat steps (*b*) and (*d*) to (*i*) above.

(*l*) Not used.

(*m*) Carefully remove SM-D-696040 from Z2 and insert it in Z5.

(*n*) Unscrew S1, reverse it and screw it in until it short circuits the center conductor of Z1.

(*o*) Repeat steps (*b*) and (*d*) to (*i*) above.

(*p*) If correct remainder is obtained proceed with coupling bandwidth test, otherwise adjust as in (*q*) and (*r*) below.

(*q*) Remove cover from L16 and turn core of L16 to adjust bandwidth, and repeat steps (*n*) and (*o*) above.

(*r*) Disconnect 50-ohm load from J1. Remove SM-B-696036 from Z7 and SM-B-696037 from Z4.

(3) *Coupling bandwidth.*

(*a*) Connect the RF output of the sweep generator to the vertical input of the oscilloscope as shown in A, figure 5–30.

(*b*) Turn signal generator to 430 MHz, measured on the counter. Turn sweep generator attenuators to 35 db and adjust sweep to display from 426 to 434 MHz.

(*c*) Reconnect cables to SM-D-696040. Turn sweep generator attenuators to 0 db.

(*d*) Turn RCVR SIG control counterclockwise to RCVR CHANNEL 460 and XMTR DUPL control to XMTR CHANNEL 600.

(*e*) Obtain a double-peaked response with equal amplitude peaks, centered on 430-MHz marker, by adjusting coupling probe depth and C13. Typical response is shown in figure 5–28.

(*f*) Adjust wro to place markers on peaks. Multiply wro frequency, as displayed on counter, by 2. Product should be 3.25 ± .03 MHz.

(*g*) If correct bandwidth is not obtained, remove cover from L14, adjust L14 and repeat step (*f*) above.

(*h*) Adjust signal generator to 705 MHz and sweep generator to display from 701 to 709 MHz, centered on 705 MHz marker.

(*i*) Turn RCVR SIG control to RCVR CHANNEL 1010 and XMTR DUPL control to XMTR CHANNEL 500.

(*j*) Obtain a double-peaked response, centered on 705 MHz marker, by adjusting coupling probe depth and C13. Adjust probe and C13 to equalize amplitudes of peaks. Required response is shown in figure 5–28.

(*k*) Adjust wro to place markers on peaks. Multiply wro frequency, as displayed on counter, by 2. Product should be 3.25 ± .03 MHz.

(*l*) Not used.

(*m*) If correct frequency is not obtained adjust C15 and C16 in equal increments and repeat step (*k*) above.

(*n*) Repeat steps (*a*) to (*m*) above.

(*o*) Remove SM-B-696037 from Z3 and insert in Z4. Carefully remove SM-D-696040 from Z5 and insert in Z3.

(*p*) Unscrew S1, reverse it and screw it in until it just short circuits the center conductor of Z1.

(*q*) Repeat steps (*a*) to (*d*) above.

(*r*) Obtain a double-peaked response with

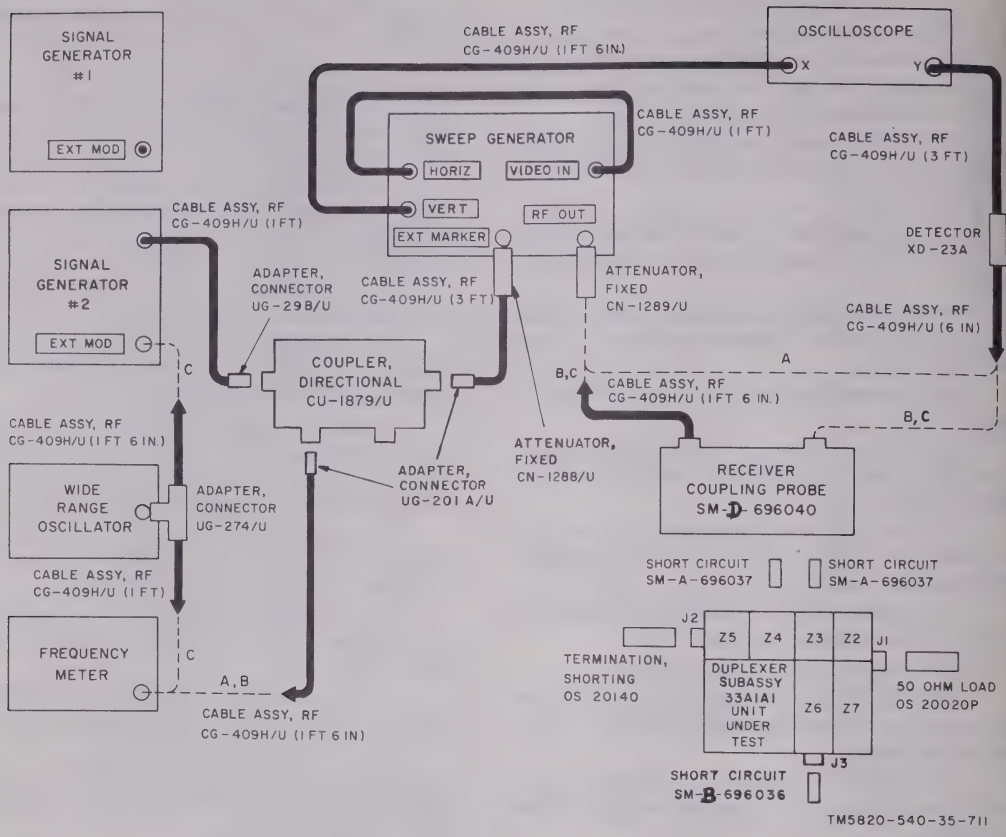


Figure 5-30. Duplexer subassembly 33A1A1 receiver filter alignment setup.

equal amplitude peaks, centered on 430-MHz marker, by adjusting coupling probe depth and C1. Typical response is shown in figure 5-28.

(*s*) Adjust wro to place markers on peaks. Multiply wro frequency, as displayed on counter, by 2. Product should be 3.25 ± .03 MHz.

(*t*) If correct frequency is not obtained, remove cover from L6, adjust core of L6 and repeat step (*s*).

(*u*) Repeat steps (*h*) and (*i*) above.

(*v*) Obtain a double-peaked response with equal amplitude peaks, centered on 705-MHz marker, by adjusting coupling probe depth and C1. Typical response is shown in figure 5-28.

(*w*) Adjust wro to place markers on peaks. Multiply wro frequency, as displayed on counter, by 2. Product should be 3.25 ± .03 MHz.

(*x*) If correct frequency is not obtained adjust C5 and C6 in equal increments, and repeat step (*w*) above.

(*y*) Remove SM-B-696037 from Z4, insert it in to Z2, and insert another SM-B-696037 in to Z5.

(*z*) Repeat procedures detailed in steps (*a*) to (*m*) above, adjusting L11 in step (*g*) for a bandwidth of 2.38 ± .03 MHz and C11 and C12 in step (*m*) for a bandwidth of 2.38 ± .03 MHz. Restore S1 to normal operation position. Remove jigs and replace covers on cavities and coils.

(4) *Filter tracking and vswr.*

(*a*) Connect test equipment as shown in A, figure 5-27.

(*b*) Turn sweep generator output attenuator to 0 db and sweep width to maximum. Insure that sweep generator ouput is level from 390 to 710 MHz.

(*c*) Mark oscilloscope response as 1.5:1 vswr and interpolate to obtain 1.25:1 mark.

NOTE

Do not readjust oscilloscope vertical gain or positioning controls during the following tests.

(*d*) Connect test equipment as shown in B, figure 5–27.

(*e*) With reference to chart below, turn RCVR SIG control *clockwise* to RCVR CHANNEL 1010 and XMTR DUPL control to XMTR CHANNEL 390. Adjust signal generator output frequency to 705 MHz, measured on the counter.

(*f*) Remove cover from Z7 and insert SM-**B**-696036.

(*g*) Adjust signal generator output amplitude for a suitable size marker, viewed on the oscilloscope.

(*h*) Adjust C1, C7, C13 and C17 for a minimum vswr, symmetrical about the 705-MHz marker. Vswr should be less than 1.25:1.

(*i*) Connect test equipment as shown in C, figure 5–27.

(*j*) Adjust wro to place markers at points where response intersects 1.5:1 vswr line, as shown in figure 5–28. Note wro frequency, as indicated on counter.

(*k*) Multiply wro frequency, obtained in step (*j*) above, by 2 to obtain bandwidth. Bandwidth should be greater than 2.0 MHz (typical 3.3 MHz).

(*l*) Not used.

(*m*) If bandwidth is out of tolerance repeat steps (*h*), (*j*), and (*k*) above.

(*n*) Repeat steps (*d*) to (*k*) above for the channel numbers and frequencies given below. If bandwidth is out of tolerance then adjust equally, the screws indicated for each cavity. After any adjustment repeat tests at previous higher frequency.

RCVR CHANNEL	Sig gen freq (MHz)	XMTR CHANNEL	Typical midband vswr	Min bandwidth (MHz)	Tuning screws (fig. 5–29)
930	665	390	1.25	2.0	B
790	595	390	1.30	2.0	C
640	545	390	1.30	2.0	D
610	505	390	1.25	2.0	E
540	470	1010	1.25	2.0	F
480	440	1010	1.25	2.0	G
440	420	1010	1.25	2.0	H
390	395	1010	1.30	2.0	J

(*o*) Turn RCVR SIG control to RCVR CHANNEL 1010. Remove covers from Z2, Z3, Z4 and Z5.

(*p*) Carefully insert SM-**B**-696037 into each cavity in turn, and insure that it neither fouls, nor is obstructed by, any of the tuning screws. If SM-**B**-696037 cannot be fully inserted, adjust obstructing screw and repeat step (*n*) above for relevant, and next higher frequency.

(*q*) Replace cavity covers.

(*r*) Perform complete test procedure (para 4–120).

5–27. Disassembly and Assembly of Channel-Frequency Indicators 33A1A1DS1, DS2 (fig. 5–31)

a. Disassembly.

(1) Remove the tape retainer mounting screws and remove the tape retainer.

(2) Remove the spool retaining rings and remove the spools with the tape.

(3) Loosen the setscrews in the sprocket wheel and remove the sprocket wheel and spur gear.

(4) Pull the channel-frequency tape free from the spools.

(5) Remove the tuning shaft (spur gear) retaining ring, and remove the tuning shaft.

(6) Remove the sleeve bearing mounting screws and remove the sleeve bearing.

b. Assembly.

(1) Uncoil one end of the channel-frequency tape, and place it over a spool and allow the tape to coil over the spool.

(2) Install a spool on the other end of the tape in a similar manner.

(3) Install the sprocket wheel and the spur gear and secure them with the sprocket wheel setscrews.

(4) Install the sleeve bearing and secure it with the two mountig screws.

(5) Install the tuning shaft and secure it with the retaining ring.

(6) Install one spool and position the tape over the sprocket wheel. Install the second spool and secure both spools with the retaining rings.

(7) Place the tape retainer in position and secure it with the two mounting screws.

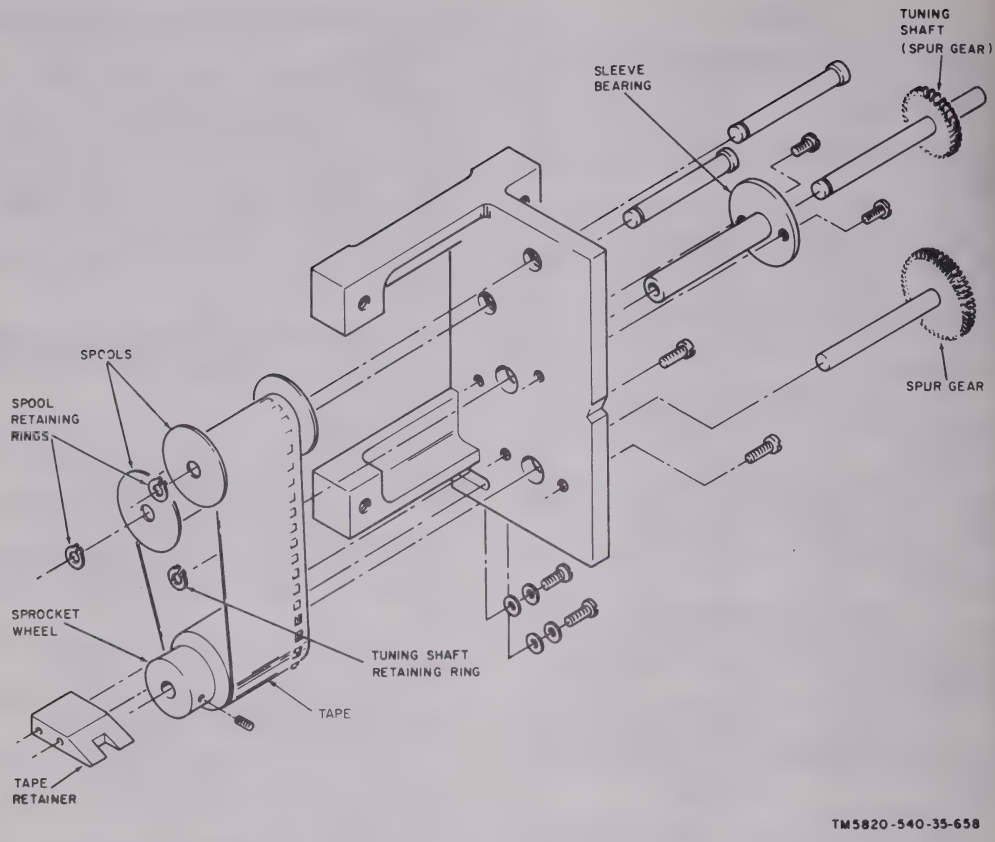


Figure 5–31. Channel-frequency indicator 33A1A1DS1, DS2, exploded view.

Section VIII. REPAIR OF AMPLIFIER-FREQUENCY MULTIPLIER AM–4322/GRC–103(V) AND AMPLIFIER-CONVERTER AM–4318/GRC–103(V) (BAND III RF HEADS)

5–28. General

This section provides depot maintenance information for the band III RF heads. The alignment, disassembly, and assembly procedures given follow from the appropriate test procedures given in chapter 4. The disassembly procedures are lengthy and presume that complete disassembly is required. The repairman should evaluate the unit under test before disassembly, and if complete disassembly is not required, only relevant sections of the text should be used. If the repairman is not familiar with the unit under repair, the unit and the mechanical drawing should be studied together so that interactions and sequences will be known after disassembly.

5–29. Additional Test Equipment Required

The following tables list the test equipment, special tools, and materials required, in addition to that given in paragraph 5–2, for maintenance of the band III RF heads.

a. Test Equipment.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Test Facility, Receiver TS–2867(V)1/GRM–95(V)	Receiver test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Generator, Signal SG–340A/G.	Signal generator No. 2

Equipment	Common name
Generator, Signal AN/USM–205.	Wide range oscillator
Meter, Frequency AN/USM–195.	Frequency meter
Dummy Load, Telonic TRM–1–1.35F.	Calibrated mismatch TRM–1–1.35F.
Dummy Load, Telonic TRM–1–1.30F.	Calibrated mismatch TRM–1–1.30F.
Generator, Sweep SG–888	Sweep generator
Detector, RF XD–23	Detector, XD–23A
50-ohm Load Omni Spectra OS20020P (2 required).	50-ohm load OS20020P
Shorting Termination Omni Spectra OS20140P.	Shorting termination OS20140P.
Filter, Low Pass TLC–1000–5EF.	Low-pass filter
Adapter-Connector Omni Spectra OS21020.	Adapter-connector

b. Special Tools and Materials.

220 inch-ounce torque screwdriver
Instrument lubricating oil MIL–L–6085
Aircraft and instrument grease MIL–G–23827
Locking and retaining compound MIL–S–22473
Coupling probe SM–D –696039
Coupling probe SM–D –696040
Transmitter cap SM–D–696551

5–30. Disassembly and Assembly of Radio Frequency Amplifier 38AR1AR1

a. General.

(1) Carefully examine the amplifier before disassembly, notice the relationship between the moving parts, and try to determine the parts which will be replaced.

(2) When an assembly of parts has been removed and is clearly serviceable, ignore the relevant disassembly instructions and proceed with the disassembly of the main unit.

(3) Disassemble the unit until the part to be replaced has been removed. Locate the reference to that part in the assembly procedures and start the reassembly from there.

(4) Disassembly and assembly procedures are provided for the output stage only. However, since the output and driver stages are identical the procedures can be applied to either stage or both stages.

(5) To remove a flanged bearing proceed as follows: Use a plastic rod with a diameter less than that of the bearing to be removed. Place the rod against the bearing, on the opposite side to the flange, and gently tap the rod with a hammer until the bearing drops out.

(6) When a pinned gear is replaced, the shaft should be replaced. To pin a gear to a shaft, proceed as follows: Position the gear on the shaft and secure it with a setscrew. Support the shaft, drill through the hub and shaft, and press the pin home. Remove the setscrew.

(7) Apply a light film of instrument lubricating oil (MIL–L–6085) to the drive screws and use aircraft and instrument grease (MIL–G–23827), sparingly, to lubricate the gears.

(8) Before disassembly use a soldering iron to soften the compound sealing the setscrews. After completion of the electrical tests (para 4–163), apply sealing, locking and retaining compound (MIL–S–22473) to all setscrews.

b. Special Tools and Materials.
220 inch-ounce torque screwdriver
Instrument lubricating oil MIL–L–6085
Aircraft and instrument grease MIL–G–23827
Locking and retaining compound MIL–S–22473

c. Disassembly Procedures.

(1) *Removal of XMTR TUNE drive mechanism* (fig. 5–32).

(*a*) Remove nut (4) and washer (5), nut (6), and washer (7).

(*b*) Remove three screws (8) and washers (9) and remove bearing retaining plate (10).

(*c*) Remove headed shoulder pin (13), clutch disk (11), and sprocket wheel (12).

(*d*) Remove the spring clip from the connector link of chain (14) and remove the chain.

(*e*) Remove two setscrews (15), two sprocket wheels (16), and two woodruff keys (17).

(*f*) Remove bushing (18), setscrew (19), spur gear (20), woodruff key (21), sprocket wheel (22), and woodruff key (23).

(*g*) Remove bearing (24), setscrew (25), spur gear (26), shouldered shaft (27), and bearing (28).

(*h*) Remove pin (30) and the three red-circled screws (1) and washers (2) holding channel-frequency indicator (29), and remove the indicator. Disengage flexible drive shaft (31) from shouldered shaft (33).

(*i*) Remove three pins (32) securing items (34), (35), and (37).

(*j*) Remove shouldered shaft (33), shaft collar (34), bevel gear (35), and two bearings (36).

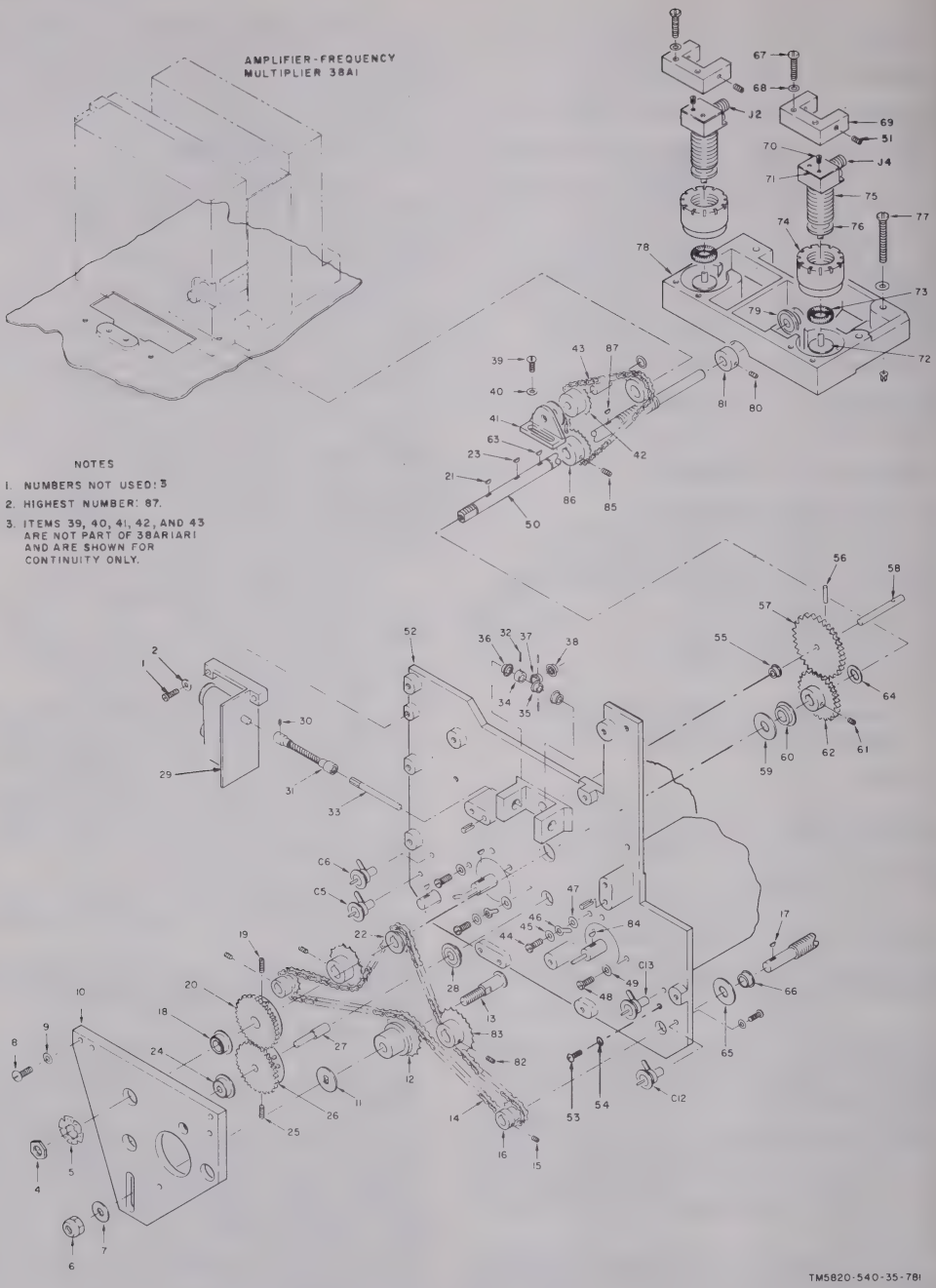


Figure 5-32. Radio frequency amplifier 38AR1AR1, tuning mechanism, exploded view.

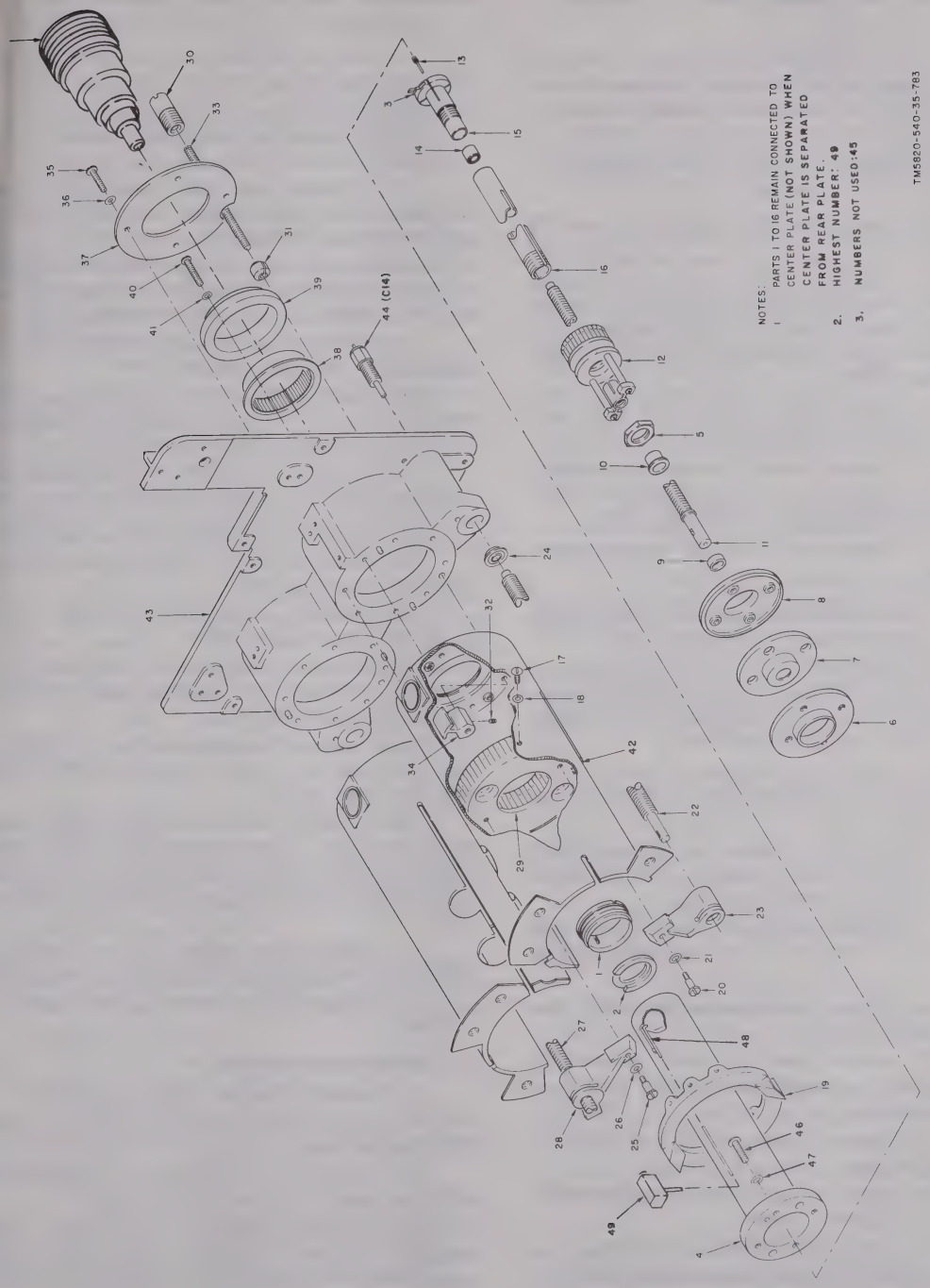


Figure 5-93. Radio frequency amplifier 38AR1AR1, cavity exploded view.

(*k*) Remove bevel gear (37) and bearing (38) from straight shaft (58).

(*l*) Not used.

(*m*) Unsolder and tag the leads connected to capacitors C5, C6, C12, and C13. Remove four screws (88) and washers (89) and remove the capacitors.

(*n*) Unsolder and tag the leads from C7 and C14 (fig. 5–33, item 44).

(*o*) Remove electronic tubes V1 and V2 (fig. 5–53).

(*p*) Remove two screws (44) and washers (45), two terminal lugs (46) and bushing insulators (47), four screws (53) and washers (54), eight screws (48) and washers (49), and remove center plate (52).

(*q*) Remove bearing (55), pin (56), spur gear (57), and straight shaft (58).

(*r*) Remove spring tension washer (59), bearing (60), setscrew (61), spur gear (62), woodruff key (63), and retaining ring (64).

(*s*) Remove two shims (65) and two bearings (66).

(2) *Disassembly of capacitor probe assemblies and separation of cavities* (fig. 5–32).

(*a*) Remove two screws (67) and washers (68) and lift guide block (69), with probe assembly, straight up. To disassemble the capacitor probe assembly proceed as follows:

1. Loosen two setscrews (51) and remove guide block (69). Remove two screws (70) and cover (71).

2. Unsolder connection between probe (72) and the coaxial connector, part of probe holder (75), and remove the probe.

3. Remove garter extension spring (73) and unscrew sleeve nut (74) from probe holder (75).

4. Remove insulator bushing (76) from probe holder (75).

(*b*) Loosen three red-circled screws (77) and separate the mechanical housing (78) from drive screw (50).

(*c*) Remove bearing (79), pin (80), and shaft collar (81).

(*d*) Remove setscrew (85), sprocket wheel (86), and woodruff key (87).

(*e*) Remove two setscrews (82), two sprocket sheels (83), and two woodruff keys (84).

(*f*) Carefully pull center plate (52) away from the rear plate (fig. 5–33, item 43) to separate the inner cavities from the outer cavities.

(3) *Disassembly of inner cavity* (fig. 5–33).

(*a*) Remove four screws (46) and washers (47) securing the cavity (4) to the center plate (fig. 5–32, item 52).

(*b*) Remove electrical contact assembly (1) and insulator bushing (2).

(*c*) Unsolder electrical contact (3) from RF cable (48) and electrical contact assembly (15) and remove cavity (4).

(*d*) Loosen nut (5) and remove bushing insulator (6), bearing housing (7), housing insulator (8), bearing (9), and sleeve bushing (10).

(*e*) Unscrew shouldered shaft (11) and remove nut (5) from cavity (16).

(*f*) Remove electrical contact assembly (12) from cavity (16) and remove electrical lead (13) from electrical contact assembly (15).

(*g*) Remove bearing (14) and separate electrical contact assembly (15) from cavity (16).

(4) *Disassembly of outer cavity* (fig. 5–33).

(*a*) Remove four screws (17) and washers (18) and cavity ring (19).

(*b*) Remove screw (20), washer (21), screw (25), and washer (26).

(*c*) Remove drive screws (22) and (27), actuators (23) and (28), bearing (24), and electrical contact assembly (29).

(*d*) Remove threaded blushing (30), lockring (31), setscrew (32), drive screw (33), and capacitor rotor (34).

(*e*) Unsolder the lead connected to RF coupling ring (38). Remove four screws (35) and washers (36) and remove capacitor retainer (37), RF coupling ring (38), and bushing insulator (39).

(*f*) Remove four screws (40) and washers (41) which secure cavity (42) to rear plate (43).

(*g*) Remove fixed ceramic dielectric capacitor (44).

d. Assembly Procedures.

(1) *Assembly of outer cavity* (fig. 5–33).

(*a*) Mount fixed ceramic dielectric capacitor (44) on rear plate (43).

(*b*) Mount cavity (42) on rear plate (43) with four screws (40) and washers (41).

(*c*) Assemble bushing insulator (39), RF coupling ring (38), capacitor retainer (37) and mount them on rear plate (43) with screws (35), and washers (36).

(*d*) Solder the lead from capacitor (44) to RF coupling ring (38).

NOTE

In step (*e*) below, coat the threads of capacitor rotor (34), setscrew (32), and machine thread bushing (30) with sealant before assembly.

(*e*) Insert lockring (31) and screw in drive screw (33). Connect capacitor rotor (34) to the drive screw, and adjust the space between the rotor capacitor and the cavity to 0.25 ± .03 inch; tighten setscrew (32). Install threaded bushing (30) and tighten to 220 ± 10 inch-ounces.

(*f*) Insert electrical contact assembly (29) in to cavity (42). Insert bearing (24) in to rear plate (43). Screw drive screw (22) in to actuator (23). Connect actuator (23) to electrical contact assembly (29) using screw (20) and washer (21).

(*g*) Turn drive screw (22) to seat it in bearing (24), and adjust the drive screw until the space between the actuator and the rear plate is 1.75 ± .005 inch.

(*h*) Install actuator (28) and drive screw (27) and connect the actuator to the electrical contact assembly (29) with screw (25) and washer (26). Insure tht electrical contact assembly (29) does not move.

(*i*) Insert tuned cavity ring (19) in to cavity (42) and secure it with four screws (17) and washers (18).

(2) *Assembly of the capacitor probe assembly* (fig. 5–32).

(*a*) Screw sleeve nut (74) on to probe holder (75). Insert insulator bushing (76) into probe holder and garter extension sprng (73) into groove on probe holder.

(*b*) Insert capacitor probe (72) into probe holder (75) and solder the probe to the coaxial connector. Secure cover (71) to probe holder (75) with two screws (70).

(*c*) Insert the capacitor assembly into mechanical drive housing (78).

(*d*) Secure the mechanical drive housing (78) to the rear plate (fig. 5–33, item 43) with the three captive screws (77).

(*e*) Secure guide block (69) to the capacitor assembly with two setscrews (51) and secure the guide block to the mechanical drive housing (78) with two screws (67) and washers (68).

(*f*) Insert bearing (79) in to mechanical drive housing (78) and secure shaft collar (81) to drive screw (50) with pin (80).

CAUTION

Do not overtighten the drive screw as it will misalign the electrical contact assembly. The space between the double actuator (fig. 5–33, item 28) and the rear plate should be 1.75 ± .005 inch.

(*g*) Adjust drive screw (50) until the shouldered end seats in bearing (79).

(3) *Assembly of inner cavity* (fig. 5–33).

(*a*) Assemble the bearing housing (7) and bushing insulators (6) and (8). Insert these items into center plate (fig. 5–32, item 52). Insert bearing (9) into bearing housing (7).

(*b*) Place sleeve bushing (10) on shaft (11) and screw the shaft into electrical contact assembly (12).

(*c*) Insert tuned cavity (16) into electrical contact assembly (12) and screw nut (5) onto the tuned cavity.

(*d*) Insert shaft (11) into bearing (9) and screw tuned cavity (16) partially in to bearing housing (7).

(*e*) Assemble electrical lead (13), electrical contact assembly (15) and bearing (14). Coat electrical contact assembly (15) with sealant and insert electrical lead (13) into shouldered shaft (11).

(*f*) Screw tuned cavity (16) into bearing housing (7) and screw electrical contact assembly (15) into the tuned cavity until the end play on shouldered shaft (11) is less than .002 inch, and tighten nut (5) against bushing insulator (8).

(*g*) Secure cavity (4) to the center plate (fig. 5–32, item 52) with four screws (46) and washers (47).

(*h*) Solder electrical contact (3) to RF cable (48) and to electrical contact assembly (15) so that item (3) does not bridge a slot of item (15).

(*i*) Insert insulator bushing (2) into cavity (4) and screw electrical contact assembly (1) into the cavity.

(4) *Assembly of rear plate and center plate* (fig. 5–32).

NOTE

Coat setscrews (85) and (61) with sealant before installation.

(*a*) Place woodruff key (87) on drive screw (50), slide sprocket wheel (86) into place and secure it with setscrew (85).

(*b*) Slide retaining ring (64) on to drive screw (50). Place woodruff key (63) on the drive screw, slide spur gear (62) into place and secure it with setscrew (61).

(*c*) Place spur gear (57) on straight shaft (58) and secure it with pin (56).

(*d*) Install spring tension washer (59), shim (65), and bearings (55), (60), and (66) in center plate (52).

(*e*) Seat straight shaft (58) in bearing (55).

(*f*) Carefully and slowly bring the center and rear plates together, slide the inner cavities in to the outer cavities (fig. 5–53, items 4 and 42) and seat the three drive screws (50) and (fig. 5–33, item 22) in bearings (55) and (66). Secure the external cavities (fig. 5–33, item 42) to the center plate (52) using ten screws (48) and washers (49).

(*g*) Secure two washers (45), terminal lugs (46), and bushing insulators (47) with screws (44).

(*h*) Secure two connector blocks (fig. 5–53, item 49) with four screws (53) and washers (54).

(5) *Assembly of XMTR TUNE mechanism* (fig. 5–32).

NOTE

Coat setscrews (15), (19), and (82) with sealant before installation. Coat setscrew (25) with sealant after the tuning stop mechanism has been set in (*o*) below.

(*a*) Place two woodruff keys (17) on the drive screws (fig. 5–53, item 22), slide sprocket wheels (16) into place and secure them with setscrews (15).

(*b*) Insert bearing (38) into center plate (52) and pin bevel gear (37) to straight shaft (58) with item (32).

(*c*) Insert two bearings (36). Slide shouldered shaft (33) into place and place collar (34) and bevel gear (35) on the shaft. Pin shaft collar (34) with item (32). Mesh bevel gears (35) and (37) and pin bevel gear (35) with item (32).

(*d*) Slide flexible drive shaft (31) on to shouldered shaft (33). Set channel-frequency indicator (29) to channel 1600, and secure it to center plate (52) with three screws (1) and washers (2).

(*e*) Place woodruff key (23) on drive screw (50) and slide sprocket wheel (22) into place. Place woodruff key (21) on drive screw (50), slide spur gear (20) into place and secure it with setscrew (19).

(*f*) Place two woodruff keys (84) on the shafts (fig. 5–33, item 11), slide sprocket wheels (83) into place and secure with setscrews (82).

(*g*) Rotate two sprocket wheels (83) counterclockwise until the electrical contact assemblies (fig. 5–33, item 12) rest against the flanges of the electrical contact assemblies (fig. 5–33, item 15).

(*h*) Rotate two sprocket wheels (83) 2¼ turns clockwise. Install roller chain (14) taking care not to rotate the five sprocket wheels (16), (22), and (83).

(*i*) Pin flexible shaft (31) to channel-frequency indicator (29) with item (30).

(*j*) Assemble headed shoulder pin (13), sprocket wheel (12), clutch disk (11), washer (7), and nut (6) on bearing retaining plate (10).

(*k*) Insert bushing (18) in to bearing retaining plate (10) and secure with three screws (8) and washers (9). Mesh sprocket wheel (12) with roller chain (14), tension the chain and tighten self-locking nut (6).

(*l*) Not used.

(*m*) Turn drive screw (50) one-half turn clockwise.

(*n*) Loosen self-locking nut (6), disengage sprocket wheel (12) from chain (14) and remove three screws (8), washers (9), and bearing retaining plate (10).

(*o*) Insert bearing (28) into center plate (52), and bearing (24) into bearing retaining plate (10). Place spur gear (26) on shouldered shaft (27) and secure it with setscrew (25).

(*p*) Seat shaft (27) in bearing (24) and engage spur gear (26) with spur gear (20) so that both stop pins are in contact and pointing away from channel frequency indicator (29).

(*q*) Install bearing retaining plate (10) and secure with three screws (8) and washers (9). Mesh sprocket wheel (12) with roller chain (14), tension the chain and tighten nut (6). Replace washer (5) and nut (4).

(*r*) Install electronic tubes V1 and V2 (fig. 5–33).

(*s*) Install capacitors C5, C6, C12, and C13 with four screws (88) and washers (89).

(*t*) Solder the leads to capacitors C5, C6, C12, and C13 (fig. 5–32) and C7 and C14 (fig. 5–33, item 44). Remove the tags.

(*u*) Assemble the RF amplifier 38AR1AR1 as part of a RF amplifier 38AR1 (para 4–199) then test and align using the procedures given in paragraph 4–163.

e. Parts List for figure 5–32.

Item	Reference symbol	Description
1	38AR1AR1H3	Screw, machine
2	38AR1AR1H3	Washer, spring tension
3	Not used	
4	38MP7H1	Nut, plain
5	38MP7H1	Washer, spring tension
6	38AR1AR1H1	Nut, self-locking
7	38AR1AR1H1	Washer, flat
8	38AR1AR1H3	Screw, machine
9	38AR1AR1H3	Washer, spring tension
10	38AR1AR1MP54	Plate, retaining, bearing
11	38AR1AR1MP33	Disk, clutch
12	38AR1AR1MP76	Sprocket wheel
13	38AR1AR1MP43	Pin, shoulder, headed
14	38AR1AR1MP29	Chain, roller
15	38AR1AR1H1	Setscrew
16	38AR1AR1MP80	Sprocket wheel
	38AR1AR1MP81	Sprocket wheel
17	38AR1AR1H1	Key, woodruff
18	38AR1AR1MP28	Bushing, sleeve
19	38AR1AR1H1	Setscrew
20	38AR1AR1MP36	Gear, spur
21	38AR1AR1H1	Key, woodruff
22	38AR1AR1MP79	Sprocket wheel
23	38AR1AR1H1	Key, woodruff
24	38AR1AR1MP14	Bearing, ball, annular
25	38AR1AR1H2	Setscrew
26	38AR1AR1MP39	Gear, spur
27	38AR1AR1MP70	Shaft, shouldered
28	38AR1AR1MP15	Bearing, ball, annular
29	38AR1AR1DS1	Indicator, channel-frequency
30	38AR1AR1MP48	Pin, straight, headless
31	38AR1AR1MP67	Shaft, drive, flexible
32	38AR1AR1MP45	Pin, straight, headless
	38AR1AR1MP46	Pin, straight, headless
	38AR1AR1MP47	Pin, straight, headless
33	38AR1AR1MP71	Shaft, shouldered
34	38AR1AR1MP31	Collar, shaft
35	38AR1AR1MP35	Gear, bevel
36	38AR1AR1MP4	Bearing, ball, annular
	38AR1AR1MP5	Bearing, ball, annular
37	38AR1AR1MP34	Gear, bevel
38	38AR1AR1MP6	Bearing, ball, annular
39	38AR1A1H2	Screw, machine
40	38AR1A1H2	Washer, spring tension
41	38MP3	Bracket, angle
42	38AR1MP3	Pin, spring
43	38AR1MP2	Chain, roller
44	38AR1AR1H1	Screw, machine
45	38AR1AR1H1	Washer, spring tension
46	38AR1AR1E26	Terminal, lug
	38AR1AR1E27	Terminal, lug
47	38AR1AR1E20	Insulator, bushnig
	38AR1AR1E21	Insulator, bushing
48	38AR1AR1H7	Screw, maching
49	38AR1AR1H7	Washer, spring tension
50	38AR1AR1MP66	Screw, drive
51	38AR1AR1H2	Setscrew
52	38AR1AR1MP51	Plate, electrical-mechanical
53	38AR1AR1H2	Screw, machine
54	38AR1AR1H2	Washer, spring tension
55	38AR1AR1MP7	Bearing, ball, annular
56	38AR1AR1MP49	Pin, straight, headless
57	38AR1AR1MP38	Gear, spur
58	38AR1AR1MP72	Shaft, straight
59	38AR1AR1H1	Washer, spring tension
60	38AR1AR1MP13	Bearing, ball, annular
61	38AR1AR1H1	Setscrew
62	38AR1AR1MP37	Gear, spur
63	38AR1AR1H1	Key, woodruff
64	38AR1AR1MP61	Ring, retaining
65	38AR1AR1MP85	Shim
66	38AR1AR1MP9	Bearing, ball, annular
	38AR1AR1MP11	Bearing, ball, annular
67	38AR1AR1H2	Screw, machine
68	38AR1AR1H2	Washer, spring tension
69	38AR1AR1MP20	Block, guide
	38AR1AR1MP21	Block, guide
70	38AR1AR1C2H2	Screw, machine
	38AR1AR1C9H2	Screw, machine
71	38AR1AR1C2MP1	Cover, variable capacitor
	38AR1AR1C9MP1	Cover, variable capacitor
72	38AR1AR1C2E2	Probe, capacitor
	38AR1AR1C9E2	Probe, capacitor
73	38AR1AR1MP73	Spring, garter, extension
	38AR1AR1MP74	Spring, garter, extension
74	38AR1AR1C2MP3	Nut, sleeve
	38AR1AR1C9MP3	Nut, sleeve
75	38AR1AR1C2MP2	Holder, probe
	38AR1AR1C9MP2	Holder, probe
76	38AR1AR1C2E1	Insulator, bushing
	38AR1AR1C9E1	Insulator, bushing
77	38AR1AR1H3	Screw, machine
78	38AR1AR1MP41	Housing, mechanical drive.
79	38AR1AR1MP12	Bearing, ball, annular
80	38AR1AR1MP44	Pin, spring
81	38AR1AR1MP32	Collar, shaft
82	38AR1AR1H1	Setscrew
83	38AR1AR1MP77	Sprocket wheel
	38AR1AR1MP78	Sprocket wheel
84	38AR1AR1H1	Key, woodruff
85	38AR1AR1H1	Setscrew
86	38AR1AR1MP75	Sprocket wheel
87	38AR1AR1H1	Key, woodruff
88	38AR1AR1H1	Screw, machine
89	38AR1AR1H1	Washer, spring tension

f. Parts List for figure 5–33.

Item	Reference symbol	Description
1	38AR1AR1E3	Contact assembly, electrical.
	38AR1AR1E4	Contact assembly, electrical.
2	38AR1AR1E22	Insulator, bushing
	38AR1AR1E23	Insulator, bushing
3	38AR1AR1E9	Contact, electrical
	38AR1AR1E10	Contact, electrical

Item	Reference symbol	Description
4	38AR1AR1Z5	Cavity, tuned
	38AR1AR1Z6	Cavity, tuned
5	38AR1AR1H1	Nut, plain, hexagon
6	38AR1AR1E14	Insulator, bushing
	38AR1AR1E15	Insulator, bushing
7	38AR1AR1MP40	Housing, bearing
	38AR1AR1MP84	Housing, bearing
8	38AR1AR1E16	Insulator, bushing
	38AR1AR1E17	Insulator, bushing
9	38AR1AR1MP18	Bearing, ball, annular
	38AR1AR1MP19	Bearing, ball, annular
10	38AR1AR1MP26	Bushing, sleeve
	38AR1AR1MP27	Bushihg, sleeve
11	38AR1AR1MP68	Shaft, shouldered
	38AR1AR1MP69	Shaft, shouldered
12	38AR1AR1E7	Contact-assembly, electrical.
	38AR1AR1E8	Contact-assembly, electrical
13	38AR1AR1E1W1	Lead, electrical
	38AR1AR1E2W1	Lead, electrical
14	38AR1AR1MP16	Bearing, ball, annular
	38AR1AR1MP17	Bearing, ball, annular
15	38AR1AR1E1	Contact-assembly, electrical.
	38AR1AR1E2	Contact-assembly, electrical.
16	38AR1AR1Z1	Cavity, tuned
	38AR1AR1Z2	Cavity, tuned
17	38AR1AR1H4	Screw, machine
18	38AR1AR1H4	Washer, spring tension
19	38AR1AR1MP57	Ring, cavity, tuned
	38AR1AR1MP58	Ring, cavity, tuned
20	38AR1AR1H2	Screw, shoulder
21	38AR1AR1H2	Washer, spring tension
22	38AR1AR1MP64	Screw, drive
	38AR1AR1MP65	Screw, drive
23	38AR1AR1MP1	Actuator, mechanical-linear.
	38AR1AR1MP2	Actuator, mechanical-linear.
24	38AR AR1MP8	Bearing, ball, annular
	38AR1AR1MP10	Bearing, ball, annular
25	38AR1AR1H2	Screw, shoulder
26	38AR1AR1H2	Washer, spring tension
27	38AR1AR1MP66	Screw, drive
28	38AR1AR1MP3	Actuator, mechanical
29	38AR1AR1E5	Contact-assembly, electrical.
	38AR1AR1E6	Contact-assembly, electrical
30	38AR1AR1MP24	Bushing, machine thread
	38AR1AR1MP25	Bushing, machine thread
31	38AR1AR1MP59	Ring, lock
	38AR1AR1MP60	Ring, lock
32	38AR1AR1H2	Setscrew
33	38AR1AR1MP62	Screw, drive
	38AR1AR1MP63	Screw, drive
34	38AR1AR1MP24	Rotor, capacitor
	38AR1AR1MP25	Rotor, capacitor
35	38AR1AR1H4	Screw, machine
36	38AR1AR1H4	Washer, spring tension
37	38AR1AR1MP55	Retainer, capacitor
	38AR1AR1MP56	Retainer, capacitor
38	38AR1AR1C1	Coupling ring, radio frequency
	38AR1AR1C3	Coupling ring, radio frequency
39	38AR1AR1E18	Insulator, bushing
	38AR1AR1E19	Insulator, bushing
40	38AR1AR1H4	Screw, machine
41	38AR1AR1H4	Washer, spring tension
	38AR1AR1Z3	Cavity, tuned
42	38AR1AR1Z4	Cavity, tuned
43	38AR1AR1MP50	Plate, electrical-mechanical
44	38AR1AR1C7	Capacitor, fixed, ceramic dielectric.
	38AR1AR1C14	
45	Not used	
46	38AR1AR1H4	Screw, machine
47	38AR1AR1H4	Washer, spring tension
48	38AR1AR1W4	Cable, RF
	38AR1AR1W5	Cable, RF
49	38AR1AR1MP22	Block, retaining, electrical connector.
	38AR1AR1MP23	Block, retaining, electrical connector.

5–31. Disassembly and Assembly of Channel-Frequency Indicator 38AR1AR1DS1

Channel-frequency indicator 38AR1AR1DS1 is similar to channel-frequency indicator 37AR1AR1DS1. Refer to paragraph 5–24 for disassembly and assembly procedures, and exploded view details.

5–32. Disassembly and Assembly of Control-Indicators 38A2 and 34A4

a. General.

(1) This paragraph describes the disassembly and assembly of control-indicators 38A2 and 34A4, which are used for channel selection in the band III transmitter and receiver RF heads.

(2) Both control-indicators provide the same binary code. However, the receiver control-indicator (34A4) is offset by 60 channels which results in a local oscillator frequency which is 30 MHz higher than the received frequency. *For example,* when 38A2 is set to channel 1648 and 34A4 is set to 1588, the two binary codes are identical.

(3) Use a soldering iron to soften the sealing compound on the setscrews.

(4) Before punching out, or pressing in pins, support the items being unpinned or pinned.

b. Special Tools.

1/16-inch driftpin punch.
No. 52 Waldes Truarc retaining ring pliers.

c. Disassembly Procedures (fig. 5–22).

(1) *General.*

(*a*) Remove the four mounting screws which secure the cover and remove the cover.

(*b*) If the fault is not known the assembly should be carefully examined before disassembly.

(2) *Removal of microswitches and command signal decoder.*

(*a*) Remove the clip securing the wiring harness to the chassis.

(*b*) Remove the two screws securing the command signal decoder; slide the decoder away from the microswitches to expose three screws.

(*c*) Remove the five screws securing the microswitch mounting plate, hold the plate in place, turn the assembly over, and with the decoder terminals facing downward, carefully lift the chassis clear of the microswitch mounting plate. Remove the 12 ball bearings and the detent spring for safekeeping.

(3) *Removal of counter wheels.*

(*a*) Slide the retaining ring away from the "units" counter.

(*b*) Slide the shaft out of its seating and remove the retaining ring.

(*c*) Remove the counter wheels, the washer, and spacer by sliding the shaft through the end plate.

(4) *Removal of cam banks Geneva gears.*

(*a*) Soften the Loctite and remove the first locking setscrew. Loosen the second setscrew securing the shaft.

(*b*) Remove the three cam banks Geneva gears and the three clips by sliding the shaft through the end wall.

(5) *Removal of cam banks and counter drive shaft.*

(*a*) Remove the pins from the main drive gear, cam bank No. 1, and the counter drive gear.

(*b*) Slide the shaft through the end wall and remove the retaining ring, the three numerical counter Geneva gears, the counter drive gear, the spring washer, the flat washer, the four cam banks, and the main drive gear.

(6) *Removal of tuning countrol shaft.*

CAUTION

The slipping clutch is preset and should not be disturbed.

(*a*) Remove the knob banking nut and the retaining ring.

(*b*) Push the front bearing out of its seat.

(*c*) Pull the shaft forward to unseat the far end, tilt the shaft and remove it through the bottom opening of the casting.

(7) *Removal of intermediate drive shaft.* Remove the pins securing the intermediate drive gear and the helical gear to the shaft. Slide the shaft out through end wall bearing No. 1.

d. Assembly Procedures (fig. 5–22).

(1) *Assembly of cam banks and counter drive shaft.*

(*a*) Slide the shaft through bearing No. 2 and slide the main drive gear on to the shaft.

(*b*) Slide the cam banks on to the shaft in the following order:

1. Cam banks No. 1 (with pinhole).
2. Cam banks No. 2 and 3 (identical).
3. Cam bank No. 4 (shortest cam bank).

(*c*) Slide the flat washer and the spring washer on to the shaft and push the shaft through the bearing in the separating wall.

(*d*) Slide the counter drive gear and Geneva gears on to the shaft. Insure that the Geneva gear half-teeth are away from the counter drive gear.

(*e*) Slide the retaining ring on to the shaft and press the shaft into the end plate bearing. Slide the retaining ring up against the bearing.

(*f*) Pin the main drive gear and cam bank No. 1. If the original counter drive gear has been replaced, pin it. If a new counter drive gear has been used it will be pinned during assembly of the counter wheels.

(2) *Assembly of microswitches and command signal decoder.*

(*a*) With the decoder terminals and switches facing downward, insert the detent spring and the 12 ball bearings.

(*b*) Carefully fit the decoder-microswitch assembly to the chassis and secure it with the five screws.

(*c*) Slide the command signal decoder into position and secure it with the two screws.

(*d*) Secure the wiring harness to the chassis.

(3) *Assembly of numerical counter.*

(*a*) Rotate cam bank No. 1 until all three cams are in their lowest position.

NOTES

1. Cam bank No. 1, and the shaft, should

remain in this position until assembly of the counter is completed.

2. A cam low position corresponds to a microswitch in the relaxed position.

(*b*) Slide the shouldered end of the counter shaft through the hole in the end plate and slide the spacer and washer onto the shaft.

(*c*) Fit the "thousands" counter on to the shaft with the 1 (38A2 and 34A4) to the front and mesh it with a Geneva gear half-tooth.

NOTE

The "thousands" counter does not have a 0.

(*d*) Fit the "hundreds" counter on to the shaft with the 6 (38A2) or 5 (34A4) to the front and mesh it with a Geneva gear half-tooth.

NOTE

The "hundreds" counter has stops fitted between numbers 1 and 2, 3 and 4.

(*e*) Fit the "tens" counter on to the shaft with the (38A2) or 8 (34A4) to the front and mesh it with a Geneva gear half-tooth.

(*f*) Position the "units" counter with the 8 (38A2 and 34A4) to the front and slide the shaft through the wheel.

(*g*) Fit the retaining ring on to the shaft, push the shaft home, and slide the retaining ring up against the "units" gear.

(*h*) Check that the number 1648 (38A2) or 1588 (34A4) is displayed to the front.

(*i*) The following applies only if a new counter drive gear is being used:

1. Mesh the counter drive gear with the "units" counter and lock it in this position with the setscrew.

2. Drill through the pinhole and press in a pin. Remove the setscrew.

(4) *Assembly of intermediate drive shaft.*

(*a*) Slide the shouldered end of the intermediate drive shaft through bearing No. 1.

(*b*) Slide the intermediate drive gear and the helical gear on to the shaft.

(*c*) Slide the shaft home and mesh the intermediate drive gear with the main drive gear.

(*d*) If the original helical gear has been replaced, pin both gears. If a new helical gear has been used, pin the intermediate drive gear.

(*e*) If a new helical gear has been used, assemble the tuning control shaft ((5) below), and lock the helical gear in position with the setscrew.

(*f*) Remove the tuning shaft (*c*(6) above), drill through the helical gear pinhole and press in a pin. Remove the helical gear setscrew.

(5) *Assembly of tuning control shaft.*

NOTE

The helical and clutch assembly, and the front bearing, should be on the shaft.

(*a*) Insert the threaded end of the shaft in the front bearing hole through the bottom opening of the casting. Mesh the two helical gears and seat the shaft in the rear bearing.

(*b*) Seat the front bearing and fit the retaining ring into the groove in the shaft.

(*c*) Screw the knob banking nut onto the shaft.

(6) *Assembly of cam banks Geneva gears.*

(*a*) Rotate cam banks No. 2 and No. 3 until all cams are in a low position. Rotate cam bank No. 4 until the S11 cam is in a low position and the S12 cam is in a high position.

NOTE

The counter should be at 1648 (38A2) or 1588 (34A4); cam bank No. 1 cams should be in low positions ((3)(*a*) above).

(*b*) With the cam banks positioned as above, slide the Geneva gear shaft through the casting and slide the Geneva gears and slips onto the shaft. Insure that the Geneva gear half-teeth are toward the counter.

(*c*) Carefully mesh the Geneva gears with the cam bank gears and slide the shaft home. Tighten the shaft securing setscrew.

(*d*) Check the mechanical assembly of the control-indicator as follows:

1. Change the counter display from 1648 to 1647 (38A2) or 1588 to 1587 (34A4) while observing the cams. The cams for S2 to S11 should go to high positions and the cam for S12 should go to a low position.

2. Change the counter display from 1647 to 1648 (38A2) or 1587 to 1588 (34A4) while observing the cams. The cams for S2 to S11 should go to low positions and the cam for S12 should go to a high position.

(*e*) Install the second setscrew to lock the setscrew securing the Geneva gear shaft.

(*f*) Apply Loctite to all setscrews.

(*g*) Replace the cover.

(*h*) Test the control-indicator using the procedure given in paragraph 4–162.

5–33. Replacement and Alignment of Duplexer Subassembly 34A1A1

a. General. This paragraph contains the replacement and alignment procedures for duplexer subassembly 34A1A1. Use the test procedures given in paragraph 4–173 to determine whether the receiver or transmitter filter, or both filters, require alignment. Due to the length and complexity of the alignment procedures, the subassembly should be retested, after alignment, using the procedures in paragraph 4–173.

b. Test Equipment and Material Required.

Equipment	Common name
Test Facility, Transmitter TS–2866(V)1/GRM–95(V).	Transmitter test facility
Test Facility, Receiver TS–2867(V)1/GRM–95(V)	Receiver test facility
Accessory Kit, Test Facilities Set MK–1173(V)1/GRM–95(V).	Accessory kit
Generator, Signal SG–340A/G	Signal generator No. 2
Generator, Signal AN/USM–205.	Wide range oscillator
Meter, Frequency AN/USM–195.	Frequency meter
Oscilloscope AN/USM–281	Oscilloscope
Generator, Sweep SG–888	Sweep generator
Detector, RF XD–23A	Detector XD–23A
50-ohm Load OS20020P (2 required).	50-ohm load
Shorting Termination OS20140P.	Shorting termination
Filter, Low-Pass TLC–1000–5EF.	Low-pass filter
Adapter-Connector OS21020	Adapter connector
Dummy Load, Telonic TRM–1–1.35F.	Calibrated mismatch TRM–1–1.35F.
Dummy Load, Telonic TEM–1–1.30F.	Calibrated mismatch TRM–1–1.30F.

c. Special Tools.

SM-D-696039, Coupling probe.
SM-D-696040, Coupling probe.
SM–D–696551, Transmitter cap.

d. Replacement Procedures (figs. 4–342 and 5–34).

(1) *Disassembly.*

(*a*) Remove amplifier-converter cover 34MP1 by following the procedure given in TM 11–5820–540–12.

(*b*) Remove control-indicator 34A4 by following the procedure given in TM 11–5820–540–12.

(*c*) Remove power supply 34PS1 by following the procedure given in TM 11–5820–540–12.

(*d*) Remove signal distribution panel 34A6 (para 4–201).

(*e*) Remove intermediate frequency amplifier 34AR1 (para 3–132).

(*f*) Remove frequency mixer stage 34A7 (para 3–133).

(*g*) Remove signal level control-monitor 34A5 (para 3–131).

(*h*) Remove speed decreaser gear assembly 34A1MP1 (para 4–205).

(*i*) Remove frequency multiplier group 34A2 (para 4–206).

(*j*) Remove radio frequency power monitor 34A3 (para 4–203).

(*k*) Remove voltage control assembly 34A1A2 (para 4–209).

(*l*) Not used.

(*m*) Disconnect 34W5P2 from J1 of low-pass filter 34FL1 and remove screws securing 34A1W1J8, 34A1W1J9, and the bottom support.

(*n*) Raise the bottom support and feed 34A1W1J8 and 34A1W1J9 through the holes in the bottom support.

(*o*) Remove screws securing terminal board 34A1W1TB1 and the wiring harness to the bottom support.

(*p*) Remove screws securing 34A1W1J3, 34A1W1J6 and 34W7J1.

(*q*) Loosen connector 34A1W1A1J2 sleeve nut and slide it down the radio frequency cable; remove screws securing 34A1W1A1J2 and move it clear of the chassis.

(*r*) Remove hardware securing the wiring harness to the electrical equipment chassis and duplexer subassembly.

(*s*) Remove locating pins and screws securing the rear support. Note number of shims.

(*t*) Remove screws securing the electrical equipment chassis; remove the chassis and the six cavity positioning rings.

(*u*) Remove remaining screws securing the wiring harness to the duplexer subassembly.

(*v*) Remove screws securing 34A1W1J4 and screws and spacers securing 34A1W1J5 and

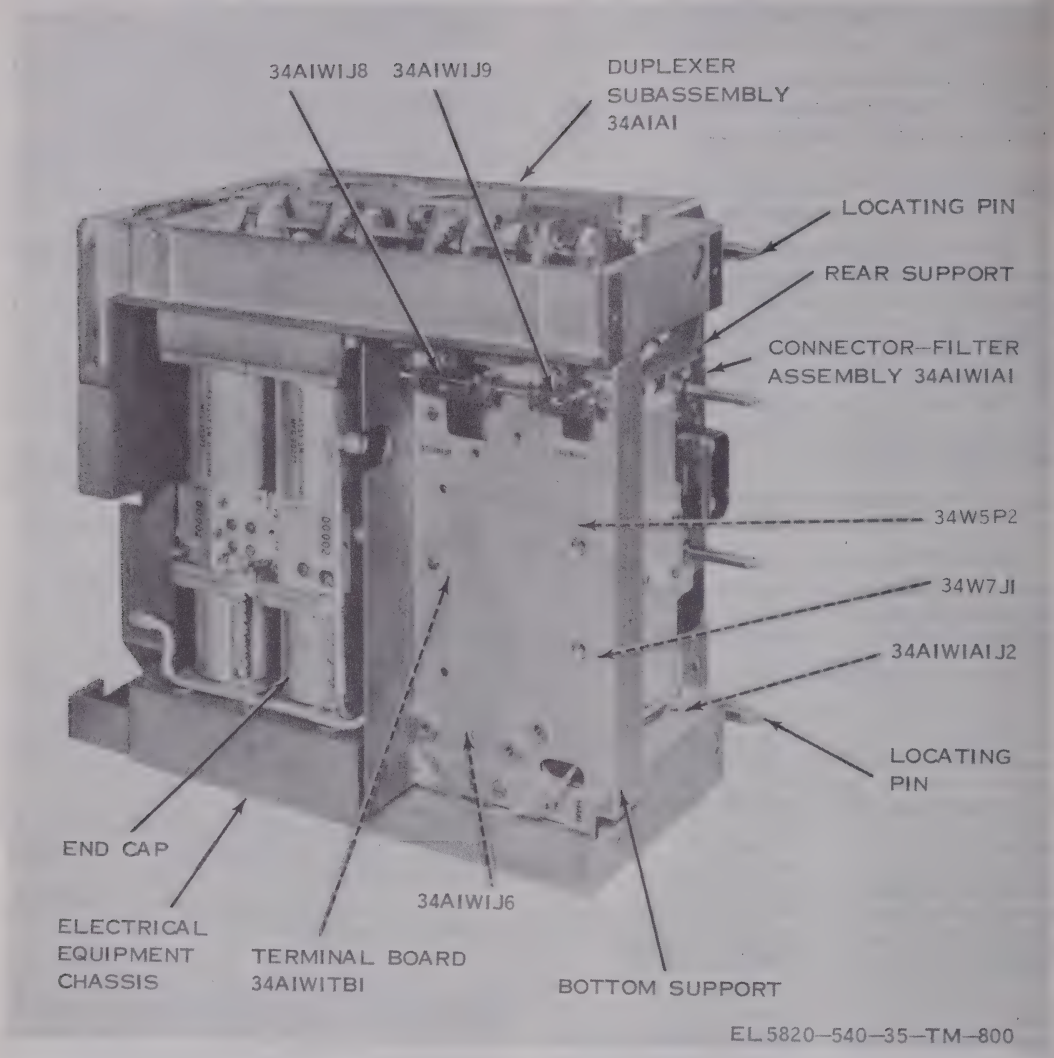


Figure 5-34. Band III receiver RF head, partially disassembled, bottom and rear view.

34A1W1J7. Remove the wiring harness complete with connector-filter assembly 34A1W1A1 and the rear support.

(2) *Reassembly.*

(*a*) Place the wiring harness, complete with filter-connector assembly 34A1W1A1 and the rear support, in position. Secure the wiring harness to the duplexer subassembly with the appropriate hardware.

(*b*) Secure 34A1W1J4, 34A1W1J5, and 34A1W1J7 with the appropriate hardware.

(*c*) Fit the cavity positioning rings to the cavity caps, place the electrical equipment chassis in position and secure it with the three screws at the front edge.

(*d*) Orient the cavity positioning rings to align the screw holes and secure the rings to the electrical equipment chassis with the appropriate hardware.

(*e*) Secure 34A1W1J3, 34A1W1J6, 34W7J1, and the wiring harness to the electrical equipment chassis with the appropriate hardware.

(*f*) Secure 34A1W1A1J2 with the appropriate hardware and tighten the connector sleeve nut.

(*g*) Install the locating pins but do not tighten the nuts. Slide the shims into position and secure the rear support with the appropriate hardware. Tighten the locating pin nuts.

(*h*) Secure the wiring harness and 34A1W1TB1 to the bottom support with the appropriate hardware.

(*i*) Feed 34A1W1J8 and 34A1W1J9 through the holes in the bottom support. Secure the connectors and the bottom support with the appropriate hardware.

(*j*) Connect 34W5P2 to J1 to low-pass filter 34FL1.

(*k*) Replace voltage control assembly 34A1A2 (para 4–209).

(*l*) Not used.

(*m*) Replace radio frequency power monitor 34A3 (para 4–203).

(*n*) Replace frequency multiplier group 34A2 (para 4–206).

(*o*) Replace speed decreaser gear assembly 34A1MP1 (para 4–205).

(*p*) Replace signal level control-monitor 34A5 (para 3–131).

(*q*) Replace frequency mixer stage 34A7 (para 3–133).

(*r*) Replace intermediate frequency amplifier 34AR1 (para 3–132).

(*s*) Replace power supply 34PS1 by following the procedure given in TM 11–5820–540–35–12.

(*t*) Replace signal distribution panel 34A6 (para 4–201).

(*u*) Replace control-indicator 34A4 by following the procedure given in TM 11–5820–540–35–12.

(*v*) Replace amplifier-converter cover 34MP1 by following the procedure given in TM 11–5820–540–35–12.

(*w*) Align amplifier-converter unit 34 (para 4–171).

e. Alignment Procedures.

(1) *Preliminary setup.*

(*a*) Remove end cap (fig. 5–34) from cavity Z7.

CAUTION

In step (*b*) below do not tighten C2.

(*b*) On cavity Z6 (fig. 5–35), turn C2 slowly clockwise until it just touches the center conductor of Z6.

(*c*) Unscrew the slug of S1 (fig. 5–35), reverse it, and turn it slowly clockwise until it just touches the inner conductor.

(*d*) Turn the XMTR DUPL control to XMTR CHANNEL 1600 and the RCVR SIG control to RCVR CHANNEL 990.

(e) Insert coupling probe SM-D-696039 into cavity Z7 and adjust the probe to clear cavity plunger. Secure coupling probe to the cavity.

(*f*) Connect the test equipment as shown in A, figure 5–36.

(*g*) Turn the sweep generator RF attenuators to 35 db and switch the 1-MHz markers on; adjust the sweep, sweep width and level limit controls to display a leveled response from 998 MHz to 1002 MHz with an amplitude of 8 cm.

(*h*) Connect cables to coupling probe (B, fig. 5–36).

(*i*) Set the sweep generator RF attenuators to 0 db and switch the marker off.

(2) *Transmitter filter cavity Q.*

(*a*) Turn signal generator MOD selector to CW and adjust the output level to +7 dbm as indicated on the signal generator output meter.

(*b*) Adjust signal generator frequency to 1000 MHZ as indicated on the counter.

(*c*) Adjust SM-D-696039 coupling probes to obtain a single-peaked response on the oscilloscope.

(*d*) Adjust XMTR DUPL control and the coupling probes to obtain a response 8 cm ± 0.5 cm in amplitude and centered on the 1000-MHz marker.

(*e*) Disconnect the directional coupler from the counter and connect the wide range oscillator to the signal generator and to the frequency meter (C, fig. 5–36).

(*f*) Set the signal generator MOD selector switch to EXT COD. Turn the wide range oscillator (wro) output frequency to approximately 250 kHz.

(*g*) Adjust the wro output level and frequency for a suitable marker level and to position markers midway between top and bottom of the response, as shown in figure 5–37.

(*h*) Multiply the wro frequency, as dis-

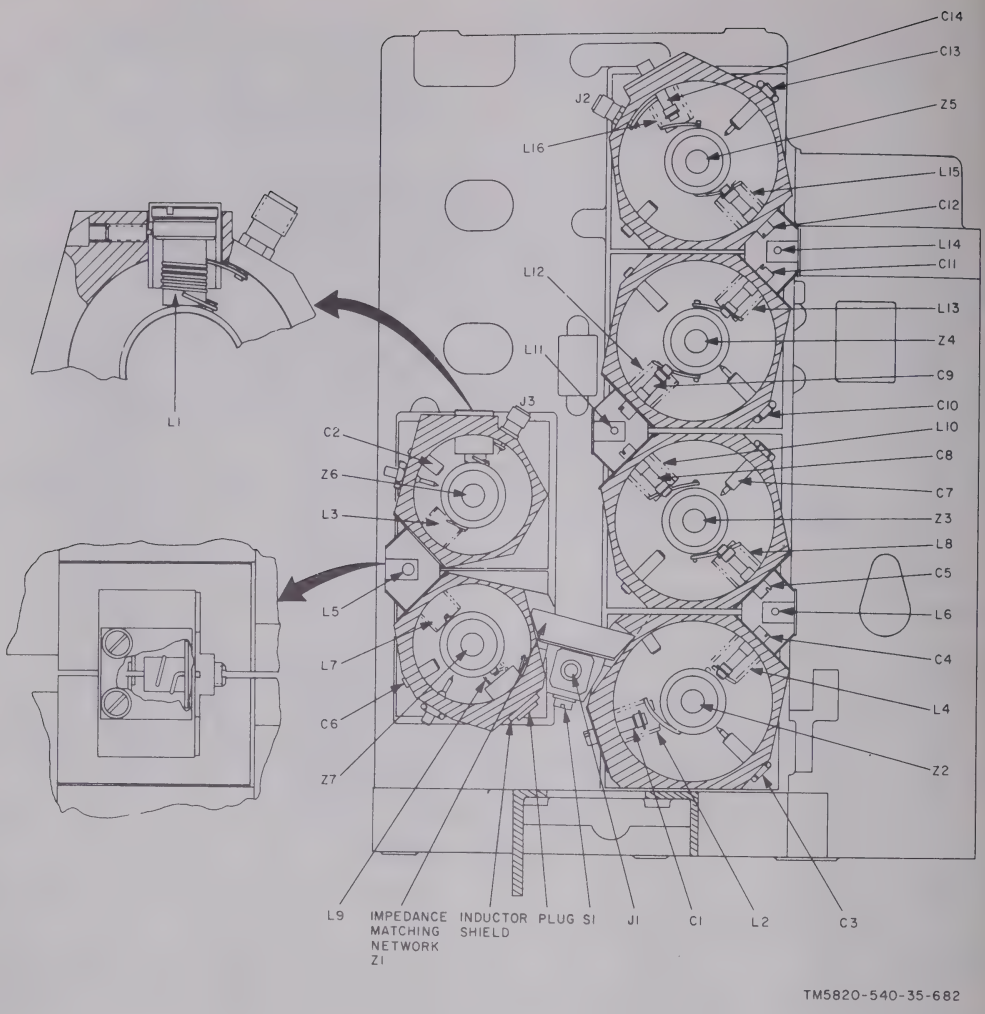


Figure 5–35. Duplexer subassembly 34A1A1, sectional view.

played on the counter, by 2 to obtain the unloaded bandwidth. Note the unloaded bandwidth.

(*i*) Unscrew the slug from switch S1 (fig. 5–35), reverse it and screw it in approximately three turns (normal position).

(*j*) Repeat steps (*a*) through (*g*) above.

(*k*) Multiply the wro frequency, as displayed on the counter, by two to obtain the loaded bandwidth. Note the loaded bandwidth.

(*l*) Not used.

(*m*) Subtract the unloaded bandwidth noted in (*h*) above from the loaded bandwidth noted in (*k*) above. The remainder (Q bandwidth) should be 4.00 ± 0.05 MHz.

(*n*) If the required Q bandwidth is obtained proceed with step (*o*) below, otherwise proceed as follows:

1. Loosen the setscrew securing L9 shield. Turn slotted plug counterclockwise but do not remove from shield. Push shield in by pressing slotted plug.

2. Rotate slotted plug clockwise until

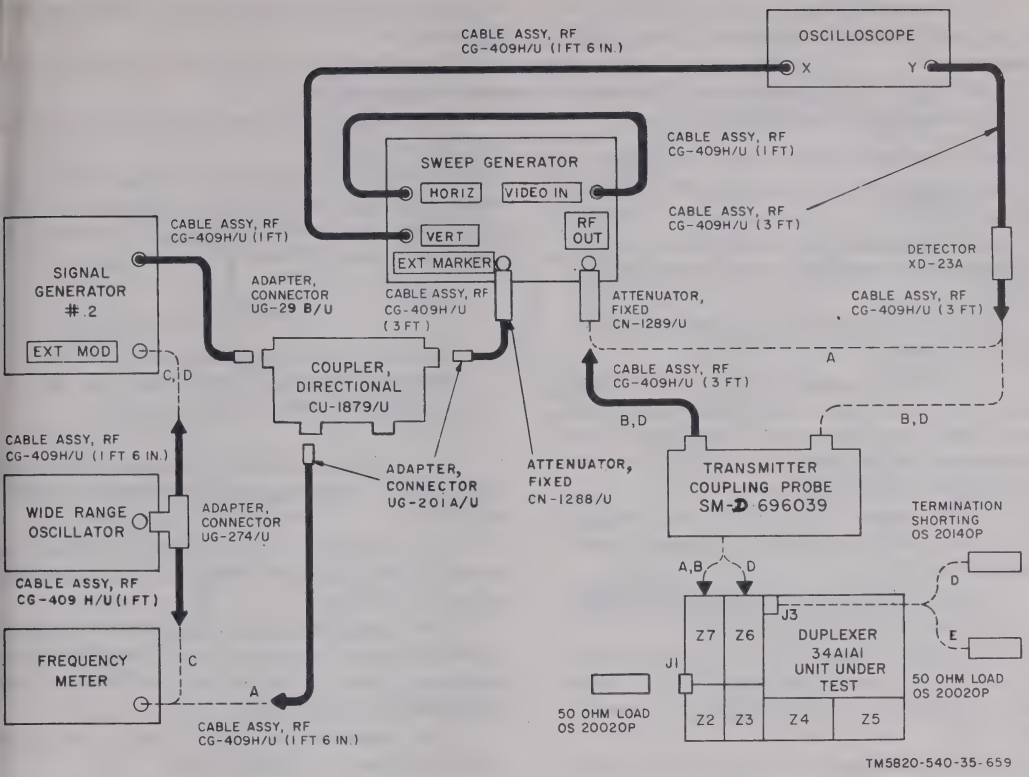


Figure 5–36. Duplexer subassembly 34A1A1, transmitter filter alignment setup.

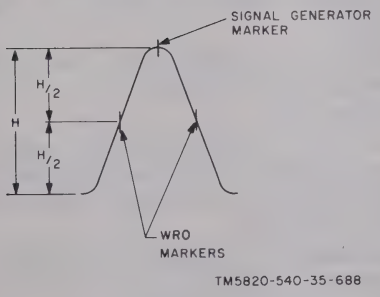


Figure 5–37. Duplexer subassembly 34A1A1 typical cavity bandwidth response.

andwidth is within tolerance. Readjust XMTR)UPL control, as required, to retain the single-eaked response centered on 1000 MHz.

3. Insure that the shield and plug are eated against the cavity and tighten the shield etaining setscrew.

4. Reverse S1 to short circuit Z1 and repeat steps (*g*) through (*m*) above.

(*o*) Remove the end cap from cavity Z6.

(*p*) Remove coupling probe SM-D-696039 from cavity Z7. Carefully insert SM-D-696039 into cavity Z6 with probe adjusted to clear the cavity plunger.

(*q*) Disconnect the 50 ohm load from J1 and connect the short circuit termination to J3 (D, fig. 5–36).

(*r*) Turn C2 counterclockwise five turns. Turn C6 slowly clockwise until it just touches the center conductor of Z7.

(*s*) Repeat steps (*a*) through (*h*) above.

(*t*) Remove the short circuit termination from J3 and connect the 50-ohm load to J3 (E, fig. 5–36).

(*u*) Repeat steps (*j*) and (*k*) above. Subtract unloaded bandwidth from loaded bandwidth. The remainder should be 4.00 ± 0.05 MHz.

(*v*) If the required bandwidth is not obtained adjust L1 using the procedure given in step (*n*) above.

(*w*) Turn C6 counterclockwise five turns. Remove 50-ohm load from connector J3.

(3) *Transmitter filter coupling bandwidth.*

(*a*) Mount transmitter cap SM–D–696551 on cavity Z7.

(*b*) Disconnect the cables from the coupling probe and connect the cables together (A, fig. 5–36).

(*c*) Turn the RCVR SIG control to RCVR CHANNEL 1200.

(*d*) Turn the sweep generator RF attenuator to 35 db and switch the 1-MHz marker ON. Adjust the sweep, sweep width and level limit controls for a leveled response from 945 to 1005 MHz, with an amplitude of 8 cm.

(*e*) Reconnect the cables to the coupling probe (D, fig. 5–36) and connect the short circuit termination to J3.

(*f*) Set the sweep generator RF attenuators to 0 db and switch the markers off.

(*g*) Adjust the coupling probe depth and C2 to obtain an equal amplitude, double-peaked response, centered on 1000 MHz as shown in figure 5–26.

(*h*) Connect the wro as shown in C, figure 5–36.

(*i*) Adjust the wro frequency and output level to place wro markers on the peaks of the response. Multiply the frequency displayed on the counter by 2. The product should be 3.60 ± 0.05 MHz.

(*j*) If the required bandwidth is not obtained, adjust L5 and repeat step (*i*) above.

(*k*) Remove the coupling probe from cavity Z6, the short circuit termination from J3 and the transmitter cap SM–D–696551 from cavity Z7. Replace the cavity end caps.

NOTE

Tighten the end cap screws fingertight, then turn each screw one-half turn, in sequence, until the end caps are secure.

(4) *Transmitter filter tracking and vswr.*

(*a*) Connect the test equipment as shown in A, figure 5–38.

(*b*) Turn the sweep generator output attenuator to 0 db, the sweep width control to maximum and switch on the 50-MHz markers. Insure that the sweep generator output is level from 695 to 1000 MHz.

(*c*) Mark the 1.5:1 vswr response on the oscilloscope graticule.

(*d*) Connect the test equipment as shown in B, figure 5–38.

(*e*) With reference to the table in step (*q*) below, turn the RCVR SIG control to RCVR CHANNEL 990 and the XMTR DUPL control to XMTR CHANNEL 1590.

NOTE

Approach this and subsequent XMTR CHANNEL settings with a clockwise rotation of the XMTR DUPL control.

(*f*) Adjust the sweep generator output frequency to 995 MHz and switch the 50-MHz markers off.

(*g*) Adjust the signal generator output frequency to 995 MHz and output level for a suitable marker amplitude.

(*h*) Adjust C2 and C6 (fig. 5–35) to obtain a symmetrical response centered on the 995-MHz marker as shown in figure 5–28. The vswr at 995 MHz should be less than 1.5:1.

(*i*) Connect the wide range oscillator (wro) as shown in C, figure 5–38.

(*j*) Adjust the wro frequency to place the wro markers at the points where the response intersects the 1.5:1 vswr calibration line. Multiply the wro frequency, as displayed on the counter, by 2. The product (bandwidth) should be greater than 2.0 MHz.

(*k*) If the bandwidth is less than 2.0 MHz repeat steps (*h*) and (*j*) above.

(*l*) Not used.

(*m*) Turn the XMTR DUPL control to XMTR CHANNEL 1510. Adjust the signal generator and sweep generator output frequencies to 955 MHz ± 0.125 kHz.

(*n*) Adjust cavity Z6 screws B equally (fig. 5–39) and then cavity Z7 screws B equally to obtain a symmetrical response, centered on 995 MHz, as shown in figure 5–28.

(*o*) Repeat step (*j*) above.

(*p*) Repeat steps (*e*) through (*g*) above and check that the response is symmetrical. If the response is asymmetrical repeat steps (*h*) and (*j*) through (*o*) above.

(*q*) Turn the XMTR DUPL and RCVR SIG controls to the channels indicated in the table

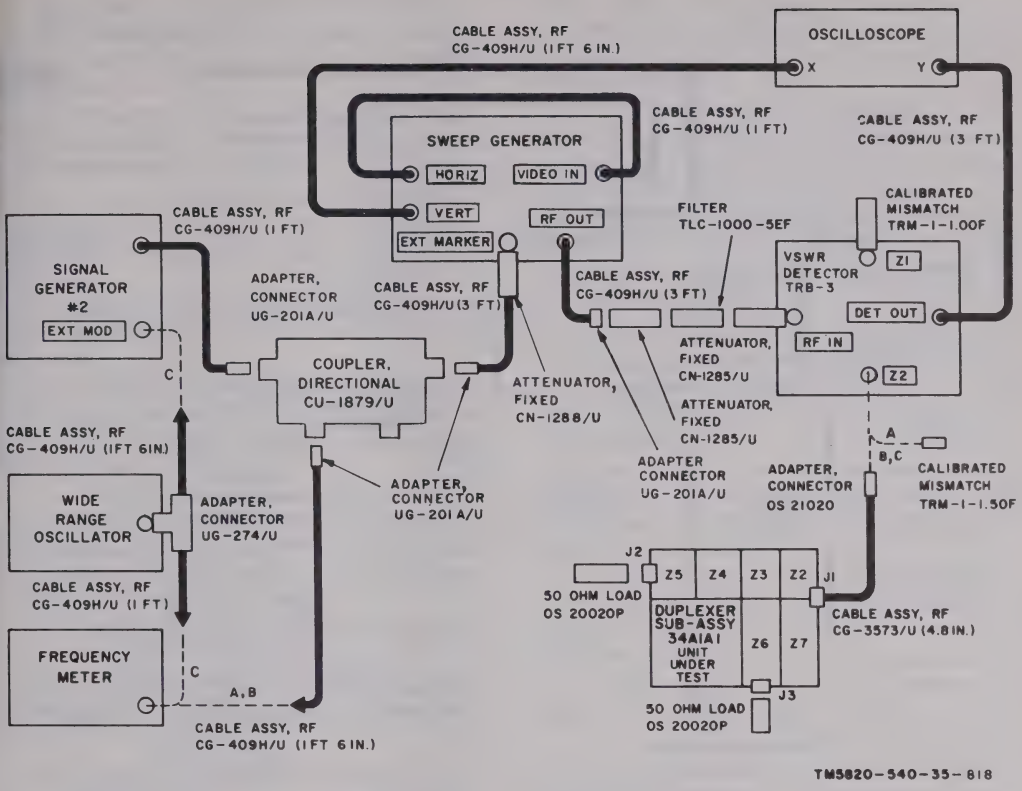


Figure 5-38. Duplexer subassembly 34A1A1 tracking and vswr test setup.

NOTE:
J SCREWS ON Z6 AND Z7 ONLY.

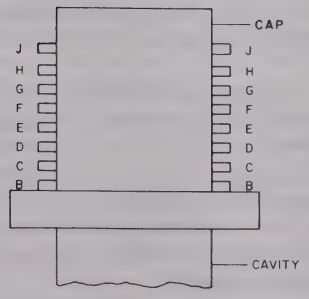


Figure 5-39. Duplexer subassembly 34A1A1, identification of cap tuning screws.

below, and adjust the signal generator and sweep generator to the frequencies shown. If the waveform is asymmetrical equally adjust the indicated tuning screws on cavities Z6 and Z7 and repeat step (*j*) above. After any adjustment repeat steps (*j*) and (*k*) above.

XMTR CHANNEL	Sig gen frequency	RCVR CHANNEL	Tuning screws (fig. 5-39)
1590	995	990	A, C2, C6 (fig. 5-35)
1510	955	990	B
1420	910	990	C
1330	865	990	D
1250	825	1600	E
1170	785	1600	F
1100	750	1600	G
1030	715	1600	H
990	695	1600	J

(5) *Receiver filter cavity Q.*

(*a*) Unscrew the slug of switch S1, reverse it, and slowly screw it in until it just touches the inner conductor.

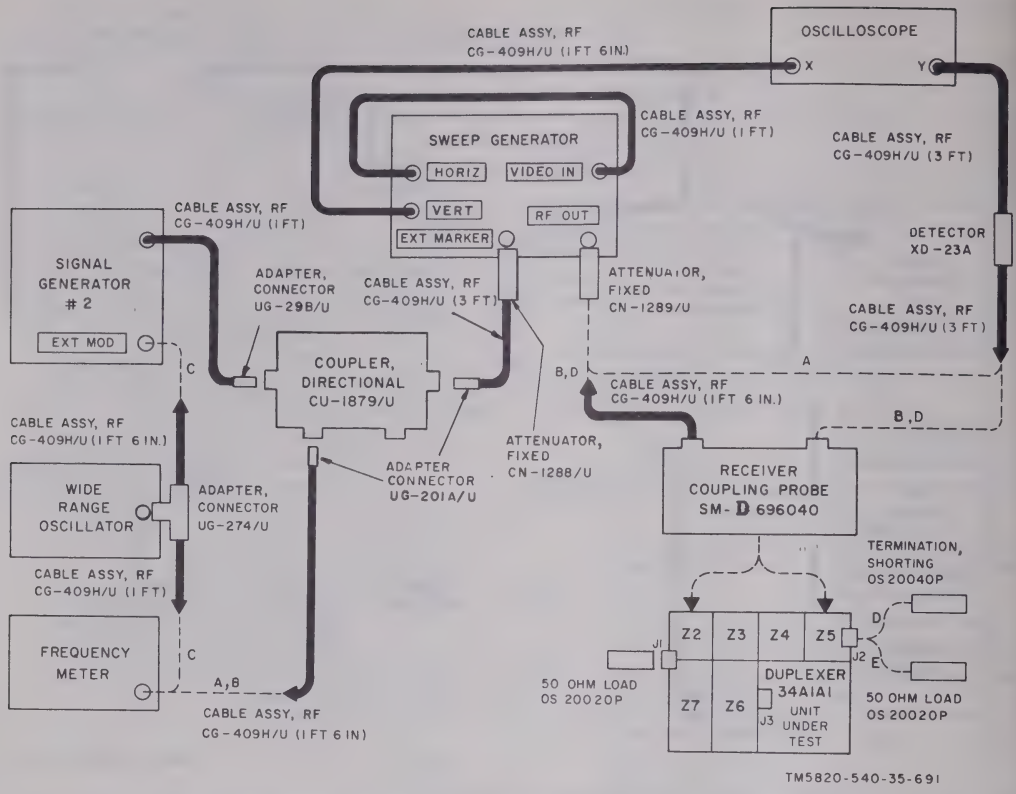


Figure 5–40. Duplexer subassembly 34A1A1, receiver filter alignment setup.

(*b*) On cavity Z3, turn C7 slowly clockwise until it just touches the center conductor.

(*c*) Remove the end cap from Z2 and insert coupling probe SM-D -696040 into cavity Z2 and adjust the probe to clear the cavity plunger. Secure the coupling probe to the cavity.

(*d*) Turn the XMTR DUPL control to XMTR CHANNEL 1600 and the RCVR SIG control to RCVR CHANNEL 1300.

(*e*) Connect the test equipment as shown in A, figure 5–40.

(*f*) Adjust the signal generator frequency to 850 MHz ± 1 MHz.

(*g*) Turn the sweep generator RF attenuators to 35 db and switch on the 1-MHz markers; adjust the sweep, sweep width and level limit controls to display a leveled response from 848 to 852 MHz.

(*h*) Connect the cables to the coupling probe (B, fig. 5–40), turn the sweep generator RF attenuators to 0 db and switch markers off.

(*i*) Adjust the coupling probes to obtain a single-peaked response, centered on the 850-MHz marker.

(*j*) Disconnect the directional coupler from the counter and connect the wro as shown in C, figure 5–40.

(*k*) Adjust the wro output level for a suitable marker level and adjust the wro frequency to position the markers midway between top and bottom of response as shown in figure 5–37.

(*l*) Not used.

(*m*) Multiply the wro frequency, as displayed on the counter, by 2 to obtain the unloaded bandwidth. Note the unloaded bandwidth.

(*n*) Unscrew the slug from S1, reverse it and screw it in approximately three turns (normal position).

(*o*) Repeat steps (*i*) through (*k*) above.

(*p*) Multiply the wro frequency, as displayed on the counter, by 2 to obtain the loaded bandwidth.

(*q*) Subtract the unloaded bandwidth from the loaded bandwidth. The remainder (Q bandwidth) should be 4.85 ± .05 MHz.

(*r*) If the required Q bandwidth is obtained proceed with step (*s*) below, otherwise adjust C1 and repeat steps (*g*), (*i*) and (*k*) through (*q*) above.

(*s*) Remove the end cap from Z5. Remove the coupling probe from cavity Z2 and insert it in to cavity Z5.

(*t*) Turn C7 counterclockwise approximately three turns and turn C10 slowly clockwise until it just touches the center conductor. Repeat step (*a*) above.

(*u*) Connect the short circuit termination to J2 (D, fig. 5–40). Repeat steps (*i*) through (*m*) above. Remove short circuit termination from J2 and connect a 50-ohm load (F, fig. 5–40) and repeat steps (*o*) through (*q*) above.

(*v*) If the required Q bandwidth is not obtained adjust C14.

(*w*) Turn C10 counterclockwise approximately three turns and disconnect the 50-ohm load from J1.

(6) *Receiver filter coupling bandwidth.*

(*a*) Remove the end cap from cavity Z4 and mount the dummy cap on cavity Z4.

(*b*) Turn C3 slowly until it just touches the center conductor of cavity Z2.

(*c*) Connect the test equipment as shown in A, figure 5–40.

(*d*) Set the signal generator to 750 MHz, measured on the counter. Turn the sweep generator attenuators to 35 db and adjust the sweep to display from 747 to 753 MHz.

(*e*) Reconnect the cables to the coupling probe and connect a short circuit termination to J2 (D, fig. 5–40).

(*f*) Set sweep generator RF attenuators to 0 db and switch the markers off.

(*g*) Turn the RCVR SIG control to RCVR CHANNEL 1100 and the XMTR DUPL control to XMTR CHANNEL 1250.

(*h*) Adjust the probe and C10 and C13 to obtain a double-peaked response with equal amplitude peaks, centered on 750 MHz, as shown in figure 5–26.

(*i*) Connect the wro as shown in C, figure 5–40. Adjust wro to place the markers on the response peaks. Multiply the wro frequency, as displayed on counter, by two. The product should be 3.45 ± 0.03 MHz.

(*j*) If the required bandwidth is not obtained adjust L14 to obtain the correct bandwidth by loosening the retaining screw and moving the protruding end of the wire up or down.

(*k*) Set the RCVR SIG control to RCVR CHANNEL 1500 and repeat steps (*c*) through (*i*) above for a sweep range of 947 to 953 MHz.

(*l*) Not used.

(*m*) If the required bandwidth is not obtained in (*i*) above, adjust C11 and C12.

(*n*) Repeat steps (*c*) through (*m*) above until the bandwidth at 750 MHz and 950 MHz is 3.45 ± 0.03 MHz.

(*o*) Remove the coupling probe from Z5 and the end caps from Z2 and Z3. Insert the coupling probe into Z3. Remove the dummy cap from Z4 and mount it on Z2.

(*p*) Turn C7 three turns counterclockwise. Turn C10 slowly clockwise until it just touches the center conductor of cavity Z4. Place S1 in the short circuit position.

(*q*) Repeat steps (6) (*c*) through (*g*) above.

(*r*) Adjust the coupling probe, C3 and C7 to obtain a double-peaked response with equal amplitude peaks, centered on 750 MHz, as shown in figure 5–26.

(*s*) Repeat step (*i*) above If the required bandwidth is not obtained adjust L6 by the method given in step (*j*) above.

(*t*) Repeat step (*k*) above. If the required bandwidth is not obtained adjust C4 and C5 equally to obtain the correct bandwidth.

(*u*) Repeats steps (*q*) through (*t*) above until the bandwidth at 750 and 950 MHz is 3.45 MHz ± 0.03 MHz.

(*v*) Turn C10 three turns counterclockwise. Turn C3 and C13 slowly clockwise until they just touch the center conductors of Z2 and Z5.

(*w*) Remove the dummy cap from Z2 and mount it on cavity Z4.

(*x*) Repeat steps (*c*) through (*j*) above to obtain a bandwidth of 2.45 ± 0.03 MHz. If the required bandwidth is not obtained adjust L11 by the method given in step (*j*) above.

(*y*) Repeat step (*k*) above. If the required bandwidth is not obtained adjust C8 and C9 equally to obtain the correct bandwidth. Repeat

steps (*x*) and (*y*) until the required bandwidth is obtained.

(*z*) Remove the coupling probe from cavity Z3 and the dummy cap from cavity Z4 and replace the end caps. Turn C3 and C13 three turns counterclockwise. Restore S1 to the normal position.

(7) *Receiver filter tracking and vswr.*

(*a*) Connect the test equipment as shown in A, figure 5–38.

(*b*) Turn the sweep generator output attenuators to 0 db and the sweep width to maximum. Set the sweep generator output frequency to 970 MHz.

(*c*) Mark the oscilloscope response as 1.5:1 vswr. Replace the 1.5:1 mismatch with the 1.4:1, 1.35:1, 1.3:1 and 1.25:1 mismatches and mark each oscilloscope response.

(*d*) Connect the test equipment as shown in B, figure 5–38.

(*e*) Turn the RCVR SIG control clockwise to RCVR CHANNEL 1540 and the XMTR DUPL control to XMTR CHANNEL 1600.

NOTE

Approach this and subsequent RCVR CHANNEL settings with a clockwise rotation of the XMTR DUPL control.

(*f*) Adjust the signal generator frequency to 970 MHz, as measured on the counter.

(*g*) Adjust C3, C7, C10 and C13 to produce a symmetrical vswr response centered on 970 MHz. The vswr should be less than 1.4:1.

(*h*) Connect the wro as shown in C, figure 5–38.

(*i*) Adjust the wro to place the markers at the points where the response intersects the 1.5:1 vswr line. Note the wro frequency, as indicated on the counter.

(*j*) Multiply the wro frequency obtained in (*i*) above by 2 to obtain the bandwidth. The bandwidth should be more than 2.0 MHz.

(*k*) Turn the XMTR DUPL control to XMTR CHANNEL 1500. If the vswr response is asymmetrical, adjust C3 for a symmetrical response. The vswr should be less than 1.4:1.

(*l*) Not used.

(*m*) Repeat steps (*i*) and (*j*) above. The bandwidth at the 1.5:1 vswr line should be greater than 2.0 MHz.

(*n*) Turn the RCVR SIG control to RCVR CHANNEL 1600 and adjust the signal generator frequency to 1000 MHz. If the vswr response is asymmetrical, adjust C3, C7, C10, and C13 for a symmetrical vswr response centered on 1000 MHz. The vswr should be less than 1.35:1.

(*o*) Repeat steps (*h*) through (*j*) above. The bandwidth should be greater than 2.0 MHz.

(*p*) Refer to the table below and repeat steps (*e*) through (*j*) above for the channel numbers and frequencies given. If the bandwidth is out of the limit given, adjust equally, the screws indicated for cavities Z2 through Z5. After any adjustment repeat the tests at the previous higher frequency.

RCVR CHANNEL	Sig & sweep gen freq (MHz)	XMTR CHANNEL	Typical midband vswr	Minimum bandwidth (MHz)	Tuning screw (fig. 5–29)
1510	955	1600	1.30	2.0	B
1420	910	1600	1.30	2.0	C
1320	865	1600	1.25	2.0	D
1250	825	1600	1.25	2.0	E
1170	785	1600	1.20	2.0	F
1090	745	1600	1.25	2.0	G
1000	700	1600	1.30	2.0	H

(*q*) Perform complete test procedure (para 4–173).

5–34. Disassembly and Reassembly of Channel-Frequency Indicators 34A1A1DS1, DS2

Channel-frequency indicators 34A1A1DS1 and DS2 are similar to channel frequency indicators 33A1A1DS1 and DS2. Refer to paragraph 5–27 for disassembly and assembly procedures, and exploded view details.

CHAPTER VI

SCHEMATIC AND BLOCK DIAGRAMS

6-1. General

This chapter contains the foldout schematic and block diagrams for Radio Set AN/GRC-103(V) 1. All text pertaining to the functioning of the radio set is in chapter 2.

6-2. Troubleshooting Data

The following information will aid the repairman in the location of the correct schematic or block diagram in this chapter.

Figure caption	Figure No.
Amplifier-monitor 5TR1A5, schematic diagram	6-1
Electrical frequency synthesizer 5TR1A2 or 1RE1A2, overall block diagram	6-2
Modulator-oscillator 5TR1A2A2 or 1RE1A2A2, schematic diagram	6-3
Frequency divider 5TR1A2A4 or 1RE1A2A4, schematic diagram	6-4
Rf oscillator 5TR1A2Y1 or 1RE1A2Y1, schematic diagram	6-5
Frequency divider 5TR1A2A9 or 1RE1A2A9, schematic diagram	6-6
Electrical synchronizer 5TR1A2A7 or 1RE1A2A7, schematic diagram	6-7
Digital electronic counter 5TR1A2A6 or 1RE1A2A6, schematic diagram	6-8
Digital electronic divider-counter 5TR1A2A5 or 1RE1A2A5, schematic diagram	6-9
Signal data converter-storer 5TR1A2A8 or 1RE1A2A8, schematic diagram	6-10
Interconnecting box 5TR1A2A1 or 1RE1A2A1, schematic diagram	6-11
Amplifier-frequency multiplier 5TR1A4, schematic diagram	6-12
Power supply 5TR1PS1, schematic-wiring diagram	6-13
Transmitter, Radio T-983(P)/GRC-103(V) and Amplifier-Frequency Multiplier AM-4320/GRC-103(V), interconnection diagram	6-14
Amplifier-Frequency Multiplier AM-4320/GRC-103(V), schematic diagram	6-15
Electronic switch 6A1 and frequency multiplier assembly 6A2, schematic diagram	6-16
Control-indicator 6A3 or 2A2, coding tables	6-17
Receiver rf head, schematic diagram	6-18
Electronic switch 2A4, schematic diagram	6-19
Radiofrequency amplifier 2A1AR1, schematic diagram	6-20
Intermediate frequency amplifier 2A1A2AR1, schematic diagram	6-21
Intermediate frequency amplifier 1RE1AR2, schematic diagram	6-22
Electrical frequency limiter discriminator 1RE1A4, schematic diagram	6-23
Video amplifier 1RE1AR1, schematic diagram	6-24
Pulse form restorer 1RE1A3, block diagram	6-25
Pulse form restorer 1RE1A3, schematic diagram	6-26
Amplifier-frequency multiplier 1RE1A5, schematic diagram	6-27
Power supply 1RE1PS1, schematic diagram	6-28
Receiver, Radio R-1329(P)/GRC-103(V), interconnection diagram	6-29
Receiver-Transmitter Order Wire RT-773/GRC-103(V), schematic diagram	6-30

CHAPTER 7

SCHEMATIC AND BLOCK DIAGRAMS—BAND II RF HEADS

7–1. General

This chapter contains the foldout schematic and block diagrams for Amplifier-Frequency Multiplier AM–4321/GRC–103(V), and Amplifier-Converter AM–4317/GRC–130(V). All text pertaining to the functioning of the band II RF heads is contained in chapter 2, paragraphs 2–56 through 2–75.

7–2. Troubleshooting Data

The following information will aid the repairman in the location of the correct schematic or block diagram in this chapter.

Figure caption	*Figure No.*
Amplifier-Frequency Multiplier AM–4321/GRC–103(V), band II transmitter RF head, schematic diagram	7–1
Amplifier-Frequency Multiplier AM–4321/GRC–103(V), band II transmitter RF head, interconnecting diagram	7–2
Frequency multiplier 37A1, schematic diagram	7–3
Control-indicator 37A2 or 33A4 coding tables	7–4
Amplifier-Converter AM–4317/GRC–103(V), band II receiver RF head, block diagram	7–5
Amplifier-Converter AM–4317/GRC–103(V), band II receiver RF head, schematic diagram	7–6
Amplifier-Converter AM–4317/GRC–103(V), band II receiver RF head, interconnecting diagram	7–7
Signal level control-monitor 33A5 or 34A5, schematic diagram	7–8
Frequency mixer stage 33A7, schematic diagram	7–9
Frequency multiplier 33A2A2 or 34A2A2, schematic diagram	7–10
Frequency multiplier 33A2A1 schematic diagram	7–11
Intermediate frequency amplifier 33AR1 or 34AR1 schematic diagram	7–12
Power supply 33PS1 or 34PS1 schematic diagram	7–13

CHAPTER 8

SCHEMATIC AND BLOCK DIAGRAMS—BAND III RF HEADS

8–1. General

This chapter contains the foldout schematic and block diagrams for Amplifier-Frequency Multiplier AM–4322/GRC–103(V) and Amplifier-Converter AM–4318/GRC–103(V). All text pertaining to the functioning of the band III RF heads is contained in chapter 2, paragraphs 2–76 through 2–96.

8–2. Troubleshooting

The following information will aid the repairman in the location of the correct schematic or block diagram in this chapter.

Figure caption	*Figure No.*
Amplifier-Frequency Multiplier AM–4322/GRC–103(V), band III transmitter RF head, schematic diagram	8–1
Amplifier-Frequency Multiplier AM–4322/GRC–103(V), band III transmitter RF head, interconnecting diagram	8–2
Amplifier-frequency multiplier 38A1, schematic diagram	8–3
Control-indicator 38A2 or 34A4, coding tables	8–4
Amplifier-Converter AM–4318/GRC–103(V), band III receiver RF head, block diagram	8–5
Amplifier-Converter AM–4318/GRC–103(V), band III receiver RF head, schematic diagram	8–6
Amplifier-Converter AM–4318/GRC–103(V), band III receiver RF head, interconnecting diagram	8–7
Frequency mixer stage 34A7, schematic diagram	8–8
Frequency multiplier 34A2A1, schematic diagram	8–9

APPENDIX A

REFERENCES

DA Pam 310–4	Index of Technical Manuals, Technical Bulletins, Supply Manuals, (Types 7, 8, and 9), Supply Bulletins and Lubrication Orders.
DA PAM 310–7	U.S. Army Equipment of Modification Work Orders.
SB 38–100	Preservation, Packaging, Packing, and Marking Materials, Supplies, and Equipment Used by the Army.
TB 746–10	Field Instructions for Painting and Preserving Electronics Command Equipment.
TB SIG 291	Safety Measures to be Observed When Installing and Using Whip Antennas, Field Type Masts, Towers, Antennas, and Metal Poles that are used with Communication, Radar, and Direction Finder Equipment.
TM 11–5820–540–12	Operator and Organizational Maintenance Manual: Radio Set AN/GRC–103(V)1.
TM 11–5820–540–35P	DS, GS, and Depot Maintenance Repair Parts and Special Tools List: Radio Set AN/GRC–103(V)1.
TM 11–5965–224–15P	Operator, Organizational, Field and Depot Maintenance Repair Parts and Special Tools Lists and Maintenance Allocation Chart: Handsets H–60/PT and H–165/U.
TM 11–6625–320–12	Operator and Organizational Maintenance Manual: Voltmeter, Meter ME–30A/U and Voltmeters, Electronic ME–30B/U, ME–30C/U, and ME–30E/U.
TM 11–6625–335–12	Operator and Organizational Maintenance Manual: Indicators, Standing Wave Ratio AN/UPM–108 and AN/UPM–108A.
TM 11–6625–366–15	Organizational, DS, GS, and Depot Maintenance Manual: Multimeter TS–352B/U.
TM 11–6625–400–12	Operator and Organizational Maintenance Manual: Meter, Modulation ME–57/U.
TM 11–6625–413–10	Operator's Manual: Thermal Noise Generator SG–419/U.
TM 11–6625–433–15	Organizational, DS, GS, and Depot Maintenance Manual Including Repair Parts and Special Tools List: Wattmeters AN/URM–98 and AN/URM–98A.
TM 11–6625–444–15	Operator, Organizational, Field and Depot Maintenance Manual: Voltmeter, Digital AN/GSM–64.
TM 11–6625–446–15	Operator, Organizational, Field, and Depot Maintenance Manual: Wattmeter AN/URM–120.
TM 11–6625–508–10	Operator's Manual: Signal Generators AN/USM–44 and AN/USM–44A.
TM 11–6625–535–15	Operator, Organizational, DS, GS, and Depot Maintenance Manual: Oscilloscope AN/USM–140A.

TM 11-6625-535-15-1	Organizational, DS, GS, and Depot Maintenance Manual: Oscilloscopes AN/USM-140B, AN/USM-140C, AN/USM-141A, and AN/USM-141B.
TM 11-6625-665-15	Organizational, DS, GS, and Depot Maintenance Manual: Generator Signal AN/USM-205.
TM 11-6625-700-10	Operator's Manual: Digital Readout Electronic Counter AN/USM-207.
TM 11-6625-1696-12	Operator and Organizational Maintenance Manual: Test Facilities Set AN/GRM-95(V)1.
TM 38-750	Army Equipment Record Procedures.

APPENDIX B

IDENTIFICATION OF ACCESSORIES IN TEST FACILITIES SET AN/GRM–95(V)1

The first three columns of the following charts list lettering that appears on the covers of the accessory compartments in the test facility set. The fourth column ("Physical identification") shows the actual markings on the accessories themselves. The charts are furnished to provide proper compartment identification in those cases where accessory marking and lid lettering are dissimilar.

Transmitter test facility

Reference designation	Manufacturer's part No.	Specification or drawing No.	Physical identification
1A2, 1A3, 1A4, 1A5, 1A6	349-035	349-035	349-035
1A7	TF-150	192-427	TF-150
1A8	TF-110	192-428	TF-110
1CP1, 1CP2 1CP3	MS-35173-274C	MIL-A-27434	UG-274/U
1CP4, 1CP5	MS-35184-914	MIL-A-27434	UG-914/U
1CP6, 1CP7, 1CP8	UG-201A/U	MIL-A-27434/37	UG-201A/U
1CP9	MS-35176-491B	MIL-A-27434	UG-491A/U
1CP10	CE-9307-15	192-442	CE-9307-15
1CP11	P5009	192-451	P5009
1CP12	51-073-6700	192-452	51-073-6700
1CP13	51-074-6700	192-453	51-074-6700
1CP14	274-QBJ	192-455	274-QBJ
1CP15, 1CP16	KN-97-03	192-456	UG-29B/U
1CP17	KN-94-09	192-457	UG-349A/U
1CP18	DB-50BNC	192-420	DB-50
1W1	457-554	457-554	457-554
1W2	457-555	457-555	457-555
1W3	457-556	457-556	457-556
1W4	457-557	457-557	457-557
1W5	457-558	457-557	457-558
1W6	457-559	457-559	457-559
1W7, 1W8	457-560	457-560	457-560
1W9	457-561	457-561	457-561
1W10	457-562	457-562	457-562
1W11	457-563	457-563	457-563
1W12	457-565	457-565	457-565
1W13	457-566	457-566	457-566
1W14	457-567	457-567	457-567
1W15	457-943	457-943	457-943
1W16, 1W17, 1W18	335-276	335-276	335-276
1W19, 1W20	335-277	335-277	335-277
1W21, 1W22 1W23	335-278	335-278	335-278
1W24, 1W25, 1W26	335-279	335-279	335-279
1W27,1W28,	335-280	335-280	335-280
1W29	335-281	335-281	335-281
1W30, 1W31	335-282	335-282	335-282
1W32	335-283	335-283	335-283
1W33	335-379	335-379	335-379
1W34	335-284	335-284	335-284
1W35	335-285	335-285	335-285
1W36	335-286	335-286	335-286
1W37	335-287	335-287	335-287
1W38	335-377	335-377	335-377
1W39	349-229	349-229	349-229
1Z1	ZM59	192-367	ZM59
1Z2	ZM16	192-454	ZM16

Receiver test facility

Reference designation	Manufacturer's part No.	Specification or drawing No.	Physical identification
2A2, 2A3	TF-50	192-421	TEXSCAN 50-OHM
2A4	TF-75	192-422	TEXSCAN 75-OHM
2A5, 2A6	TF-91	192-423	TF-91
2A7	TF-600	192-424	TF-600
2A8	FT-2K	192-462	FT-2K
2CP1, 2CP2, 2CP3	MS-35173-274C	MIL-A-27434	UG-274C/U
2CP4, 2CP5	KN-94-09	192-457	UG-349A/U
2CP6	51-074-6800	192-441	51-074-6800
2CP7, 2CP8	MS-35184-914	MIL-A-27434	UG-914/U
2CP9	KN-97-03	192-456	UG-29B/U
2CP10, 2CP11 2CP12	UG-201A/U	MIL-A-27434/37	UG-201A/U
2CP13, 2CP-14	CE-9307-15	192-442	CE-9307-15
2CP15	21040	192-447	21040
2CP16, 2CP17	P5009	192-451	P5009
2CP18, 2CP19	KD-94-01	192-461	UG-565A/U
2CP20	MS-35176-491B	MIL-A-27434	UG-491B/U
2W1	457-569	457-569	457-569
2W2	457-570	457-570	457-570
2W3	457-571	457-571	457-571
2W4	457-572	457-572	457-572
2W5	457-573	457-573	457-573
2W6	457-574	457-574	457-574
2W7	457-575	457-575	457-575
2W8, 2W9	457-576	457-576	457-576
2W10	457-577	457-577	457-577
2W11	457-578	457-578	457-578
2W12	457-564	457-564	457-564
2W13, 2W14 2W15, 2W16	335-276	335-276	335-276
2W17, 2W18, 2W19, 2W20	335-277	335-277	335-277
2W21, 2W22, 2W23, 2W24	335-279	335-279	335-279
2W25	335-280	335-280	335-280
2W26	335-283	335-283	335-283
2W27	335-289	335-289	335-289
2W28	335-290	335-290	335-290
2W29, 2W30, 2W31	335-291	335-291	335-291
2W32	334-578	334-578	334-578
2W33	349-234	349-234	349-234
2W34	335-377	335-377	335-377

Accessory kit

Reference designation	Manufacturer's part No.	Specification or drawing No.	Physical identification
3A14	TRK-3A	192-408	TRK-3A
3A15	535MB	192-409	535MB
3A16	535MC	192-410	535MC
3A17	535MN	192-411	535MN
3A18	535FB	192-412	535FB
3A19, 3A20	CD50	192-414	TEXSCAN CD50
3A21	3020A	192-415	3020A
3A22	CD50	192-416	CD50
3A23	192-337	192-337	192-337
3A24	DA-437/GRC-103(V)	335-887	DA-437/GRC-103(V)
3A25	TF-50	192-421	TEXSCAN 50-OHM
3A26	TF-75	192-422	TEXSCAN 75-OHM
3A27	TF-91	192-423	TF-91
3A28	TF-600	192-424	TF-600
3A29	10514A	192-426	10514A
3A30	455-936	455-936	455-936
3AT1	Model 50-3	192-368	50-3
3AT2, 3AT3	HP-8491A	192-393	8491A
3AT4	AT-75-10	192-394	AT-75-10
3AT5	AT-75-20	192-395	AT-75-20
3AT6	TC-50A	192-405	TC-50A
3AT7	TB-50A	192-406	TB-50A
3AT8	TE-50A	192-407	TE-50A

Reference designation	Manufacturer's part No.	Specification or drawing No.	Physical identification
3AT9	FP-50	192-396	FP-50-3 DB
3AT10	FP-50	192-397	FP-50-6 DB
3AT11	FP-50	192-398	FP-50-10 DB
3AT12	FP-50	192-404	FP-50-20 DB
3FL1	TTF-72-5-3EE	192-417	TTF-72-5-3EE
3FL2	TTF-125-5-3EE	192-418	TTF-125-5-3EE
3FL3	TTF-312.5-5-3EE/2	192-419	TTF-312.5-5-3EE2
3FL4, 3FL5	TLC-405-8FF-1	192-425	TLC-405-8FF1
3S1	TS-100A	192-413	TS-100A

APPENDIX C

PARTS BREAKDOWN OF RADIO SET AN/GRC–103(V)1

Radio Set AN/GRC–103(V)1
- Transmitter, Radio T–983(P)/GRC–103(V)
  - Radio transmitter 5TR1
    - Monitor panel 5TR1A1
      - Electrical connector assembly 5TR1A1A1
      - Alarm control 5TR1A1A2
    - Power supply 5TR1PS1
      - Power supply subassembly 5TR1PS1A1
      - Power supply subassembly 5TR1PS1A2
      - Voltage regulator amplifier 5TR1PS1AR1
        - Voltage regulator amplifier 5TR1PS1AR1AR1
      - Power supply 5TR1PS1PS1
    - Electrical frequency synthesizer 5TR1A2
      - Interconnecting box 5TR1A2A1
      - Interconnecting box subassembly 5TR1A2A1A1
      - Modulator-oscillator 5TR1A2A2
      - Amplifier-monitor 5TR1A2A3
      - Frequency divider 5TR1A2A4
      - Digital electronic divider-counter 5TR1A2A5
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By Order of the Secretary of the Army:

W. C. WESTMORELAND,
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Official:

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Major General, United States Army,
The Adjutant General.

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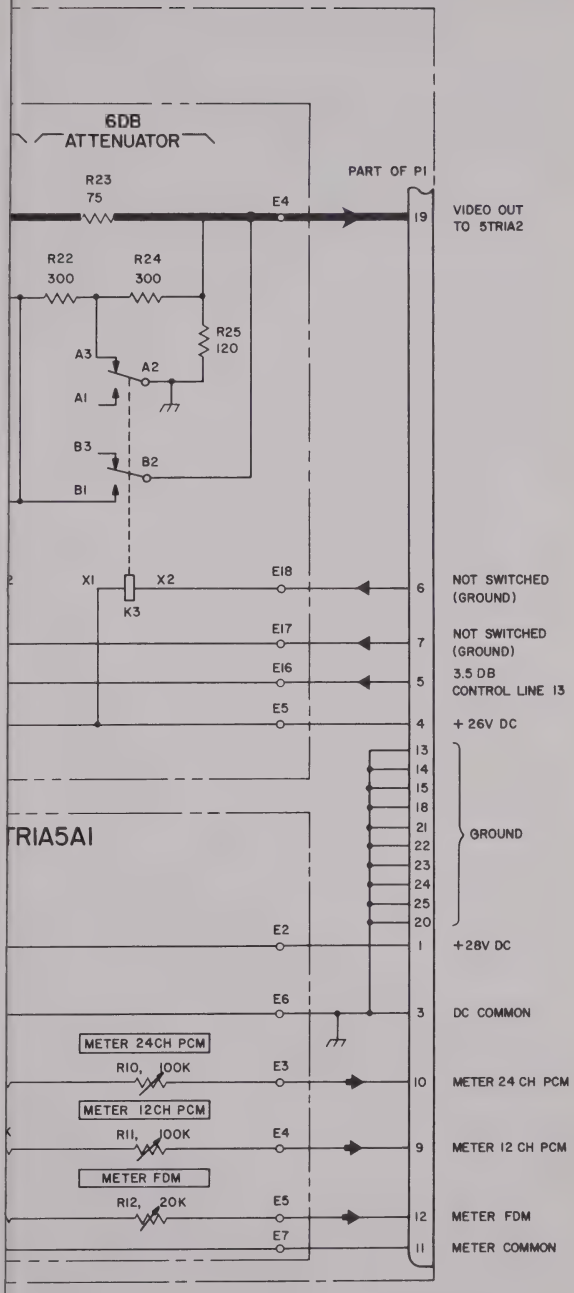


TM5820-540-35-11

NOTES:

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. A1 B2 X2 B3 / A3 X1 A2 B1 — RELAY BASE PINS AS VIEWED FROM THE PIN END

3. MAJOR FUNCTIONAL FLOW
SECONDARY SIGNAL FLOW
SIGNAL PATH TO ENERGIZE RELAY
DC METERING FLOW
FEEDBACK SIGNAL PATH

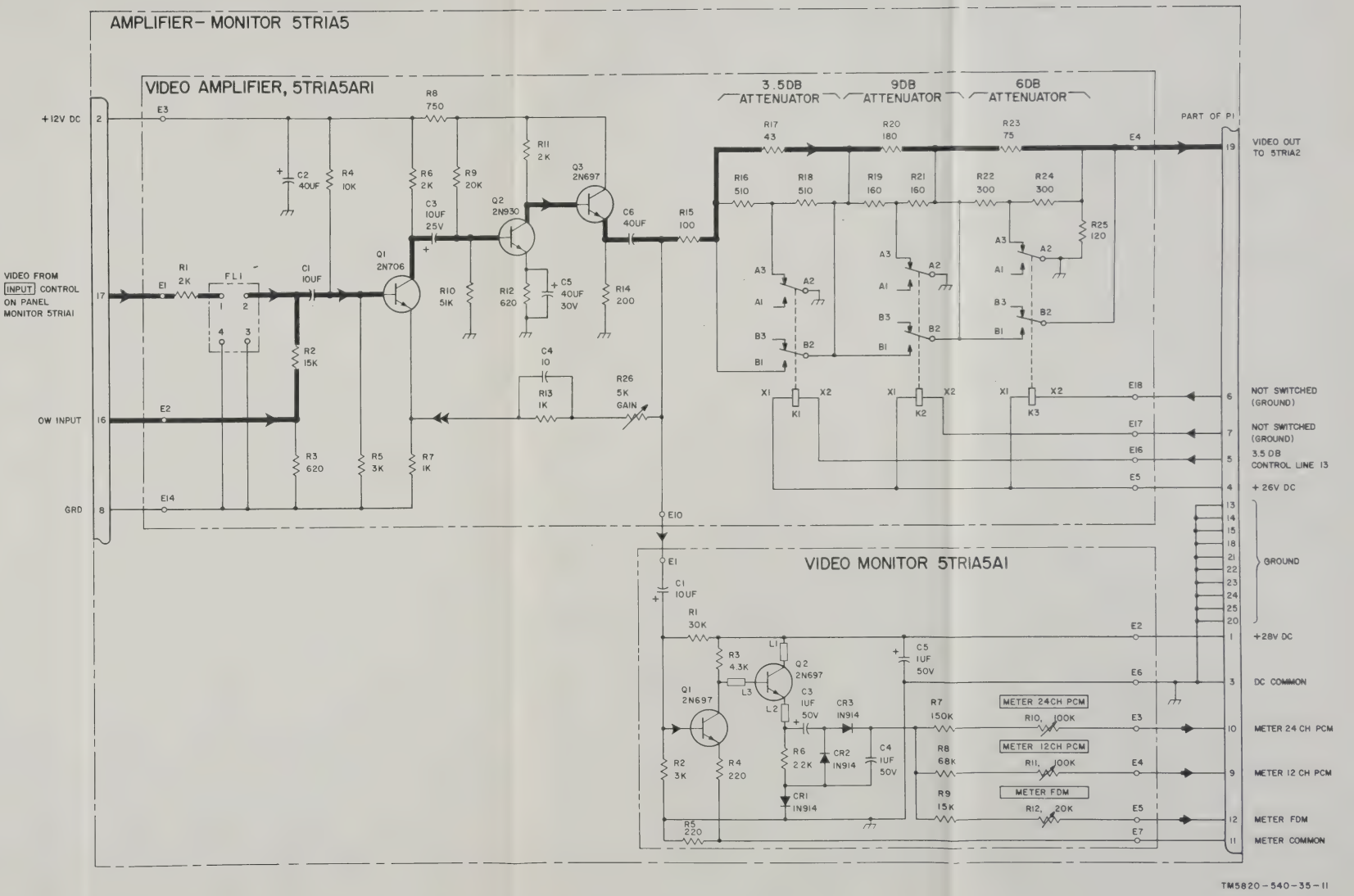
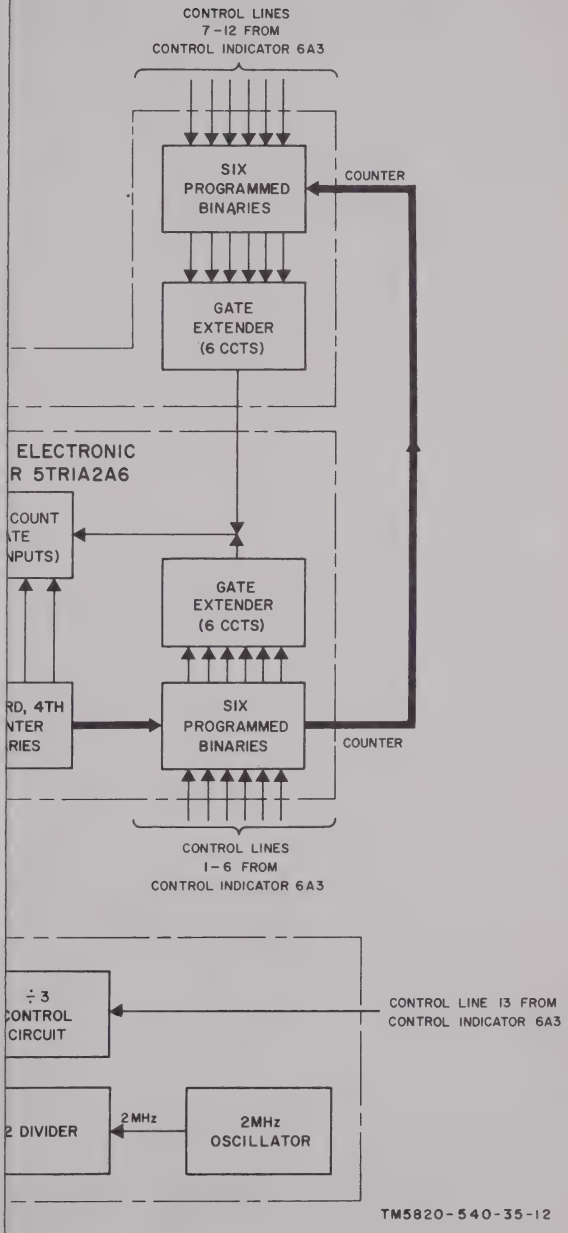


Figure 6-1. Amplifier-monitor 5TR1A5, schematic diagram.


CONTROL LINES
7-12 FROM
CONTROL INDICATOR 6A3
SIX
PROGRAMMED
BINARIES
COUNTER
GATE
EXTENDER
(6 CCTS)
ELECTRONIC
R 5TRIA2A6
COUNT
TE
NPUTS)
GATE
EXTENDER
(6 CCTS)
RD, 4TH
NTER
RIES
SIX
PROGRAMMED
BINARIES
COUNTER
CONTROL LINES
1-6 FROM
CONTROL INDICATOR 6A3
÷3
CONTROL
CIRCUIT
CONTROL LINE 13 FROM
CONTROL INDICATOR 6A3
2 DIVIDER
2MHz
2MHz
OSCILLATOR
TM5820-540-35-12

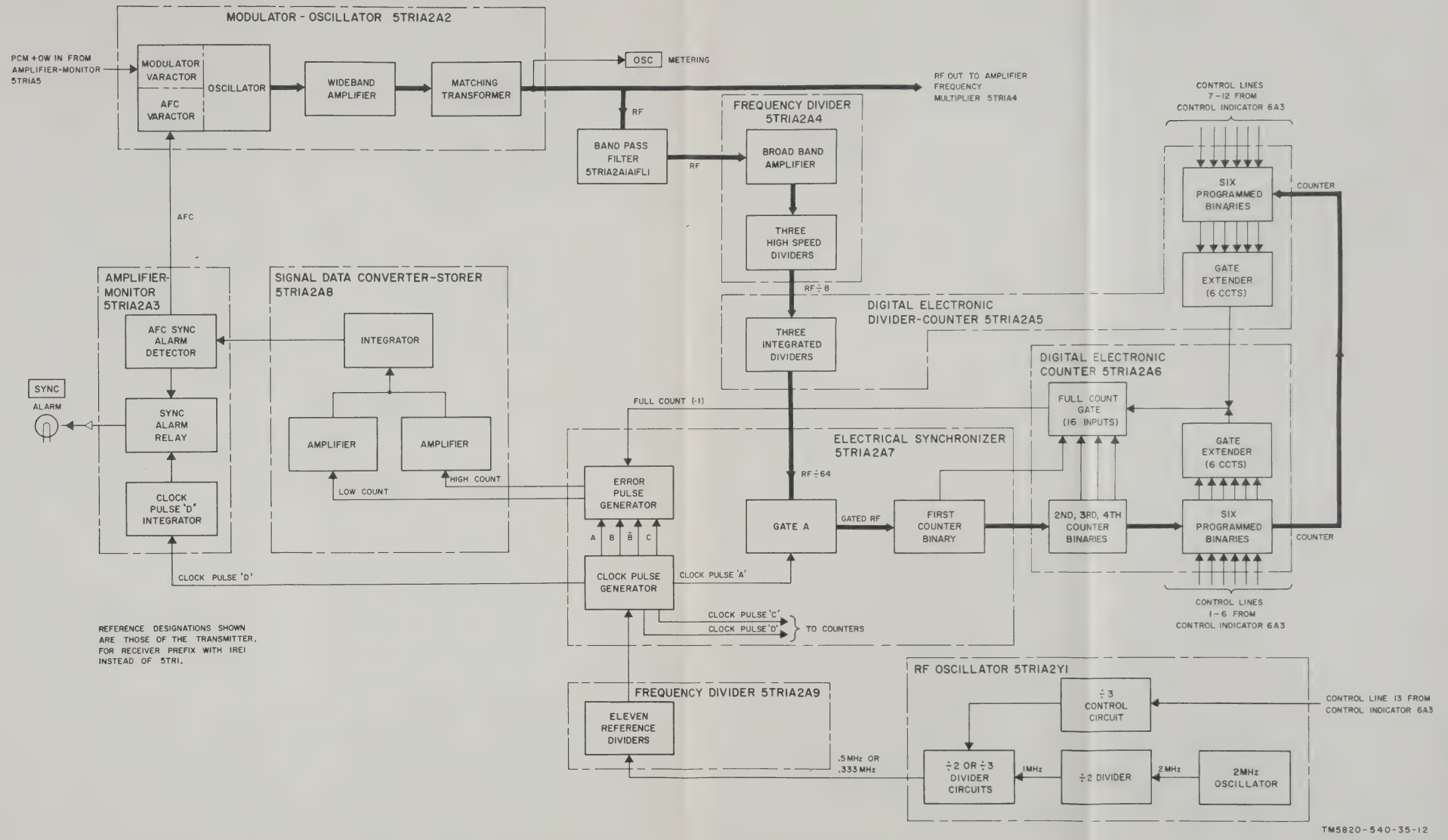
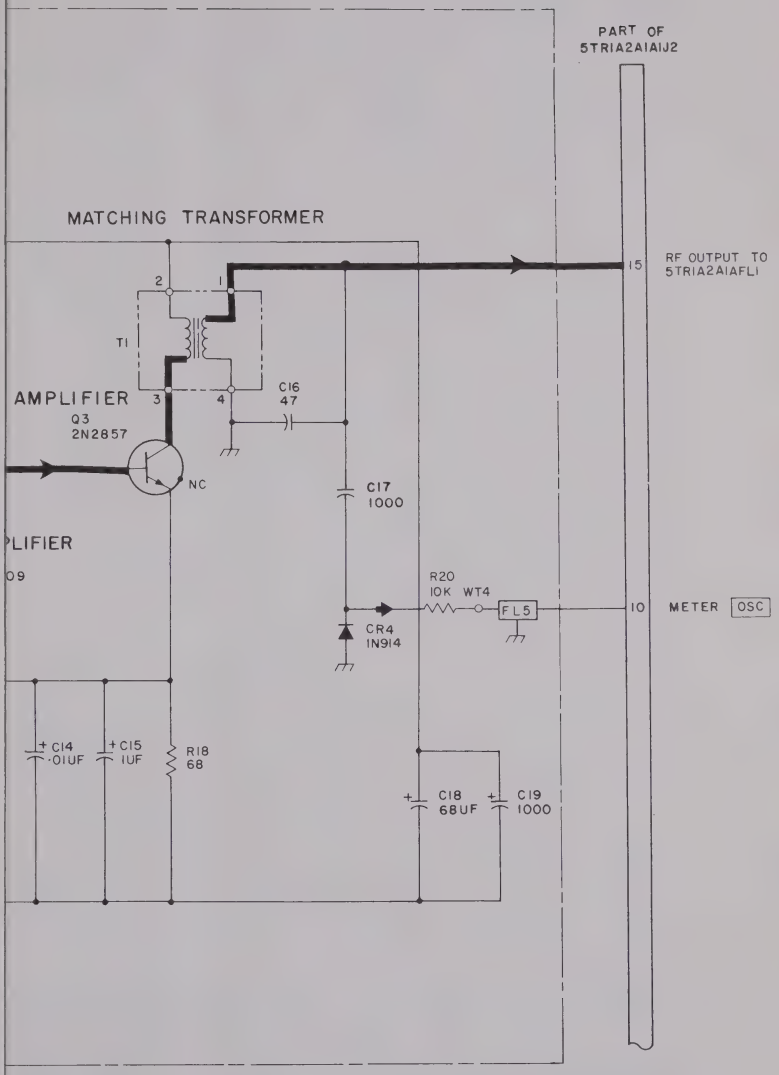


Figure 6-2. Electrical frequency synthesizer 5TR1A2 or 1REIA2, overall block diagram



TM5820-540-35-14

NOTES

1-

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2-

MAJOR FUNCTIONAL FLOW

FEEDBACK SIGNAL PATH

DC METERING SIGNAL

REFERENCE SIGNAL VOLTAGE

3-

THE VOLTAGES SHOWN ARE THOSE USED IN THE TRANSMITTER. FOR RECEIVER CONVERT AS FOLLOWS:

TRANSMITTER	RECEIVER
+12 V DC	0V
0V	+12 V DC

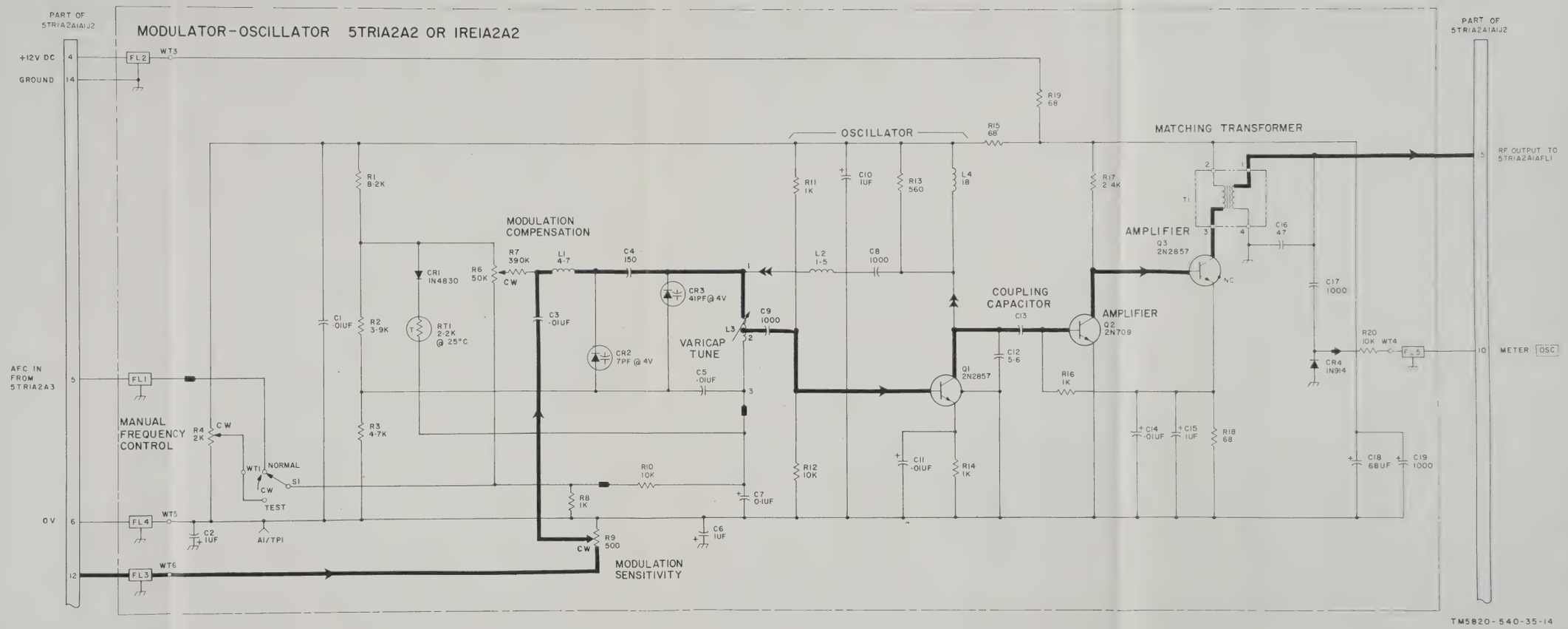
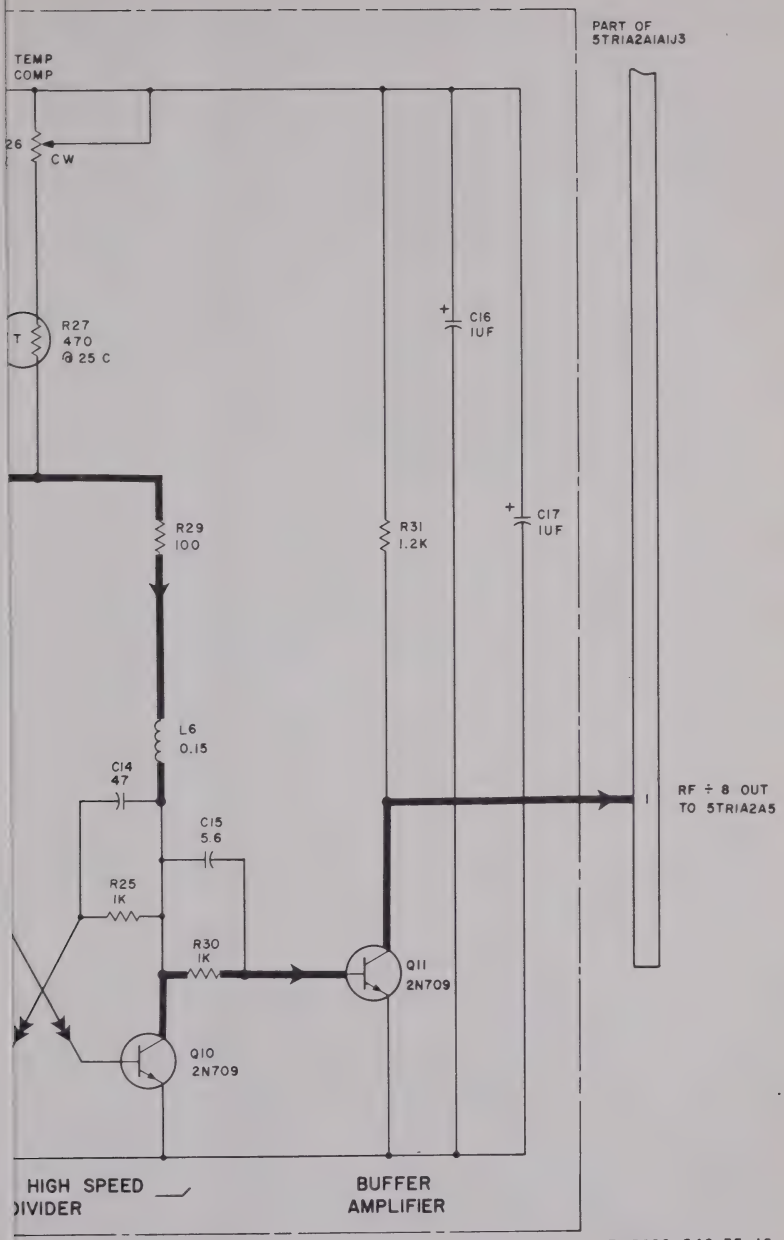


Figure 6-3. Modulator-oscillator 5TR1A2A2 or 1RE1A2A2, schematic diagram.



TM5820-540-35-16

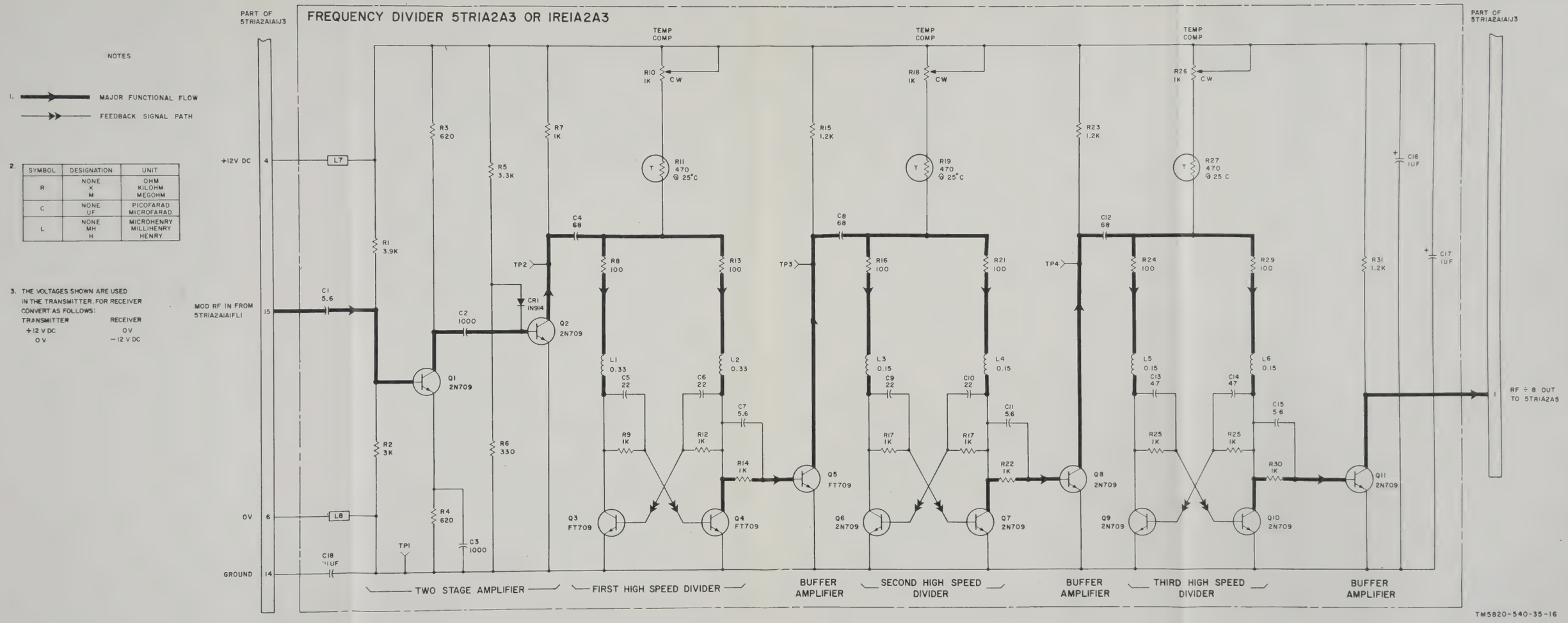
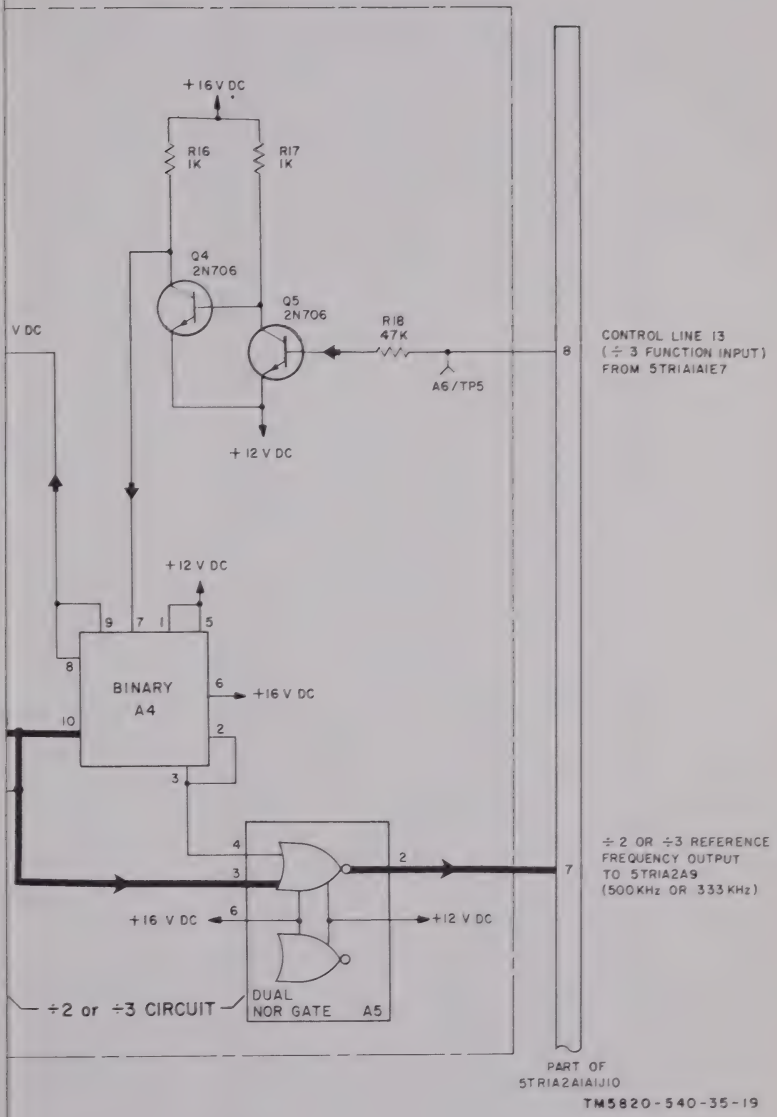


Figure 6-4. Frequency divider 5TR1A2A4 or 1RE1A2A4, schematic diagram.



TM5820-540-35-19

NOTES

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. MAJOR FUNCTIONAL FLOW
FEEDBACK SIGNAL PATH
GATING OR SYNCHRONIZING SIGNAL

3. THE VOLTAGES SHOWN ARE THOSE USED IN THE TRANSMITTER. FOR RECEIVER CONVERT AS FOLLOWS

TRANSMITTER	RECEIVER
+16 V DC	+4 V DC
+12 V DC	0V
0V	+12 V DC

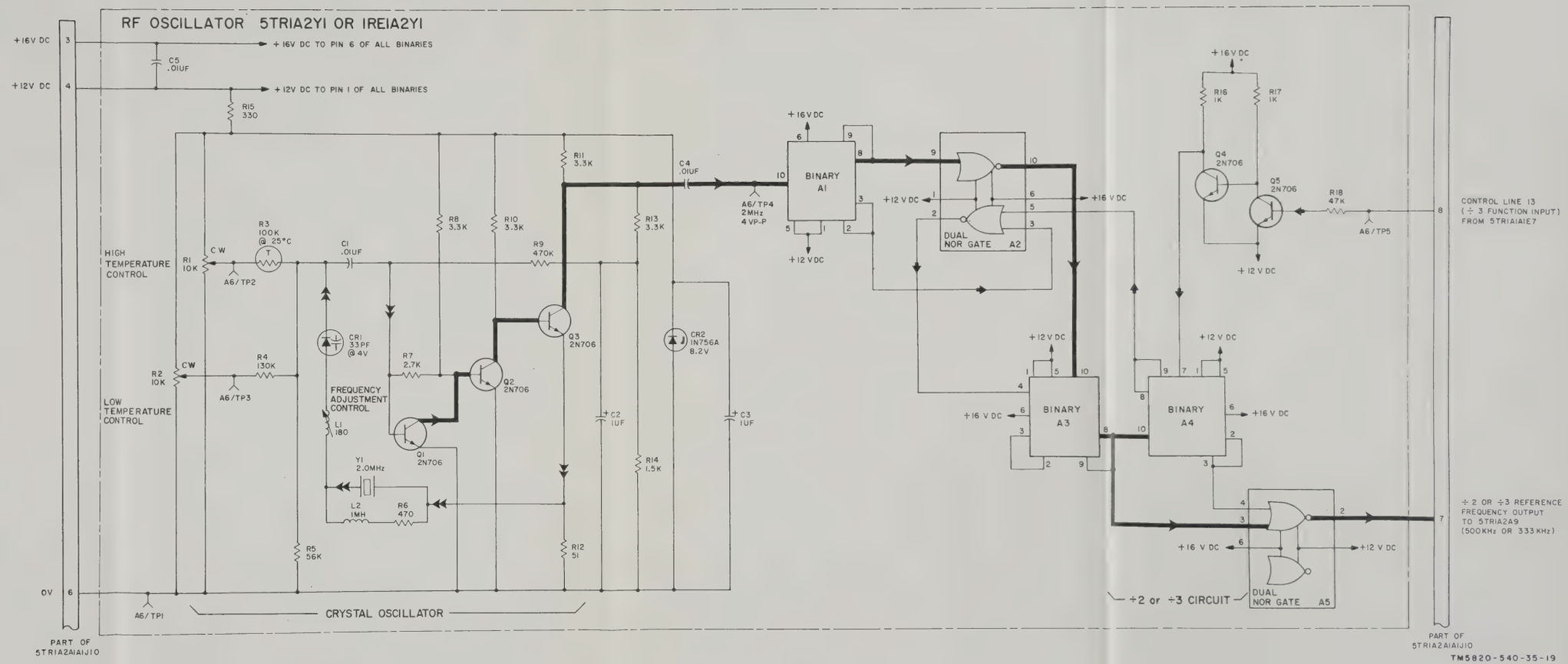
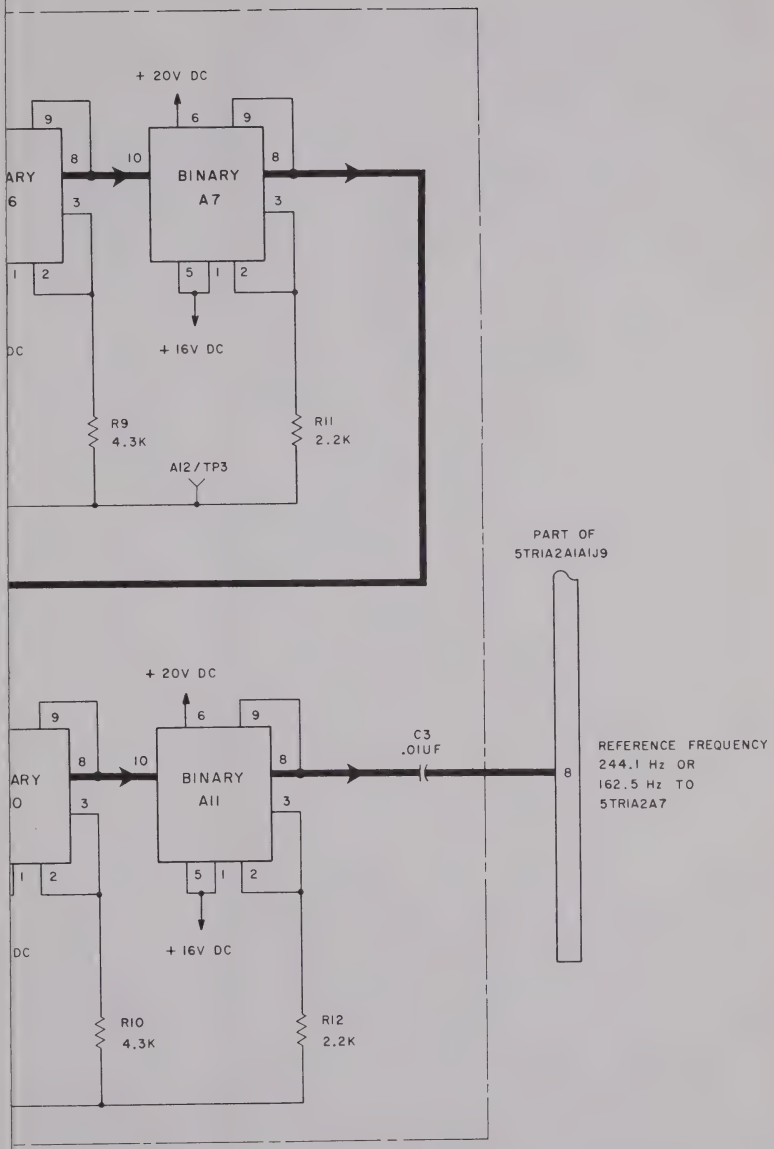


Figure 6-5. Rf oscillator 5TR1A2Y1 or 1RE1A2Y1, schematic diagram.



TM5820-540-35-21

NOTES

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. ——→ MAJOR FUNCTIONAL FLOW

3. THE VOLTAGES SHOWN ARE THOSE FOR TRANSMITTER. FOR RECEIVER CONVERT AS FOLLOWS:

TRANSMITTER	RECEIVER
+ 20V DC	+ 8V DC
+ 16V DC	+ 4V DC

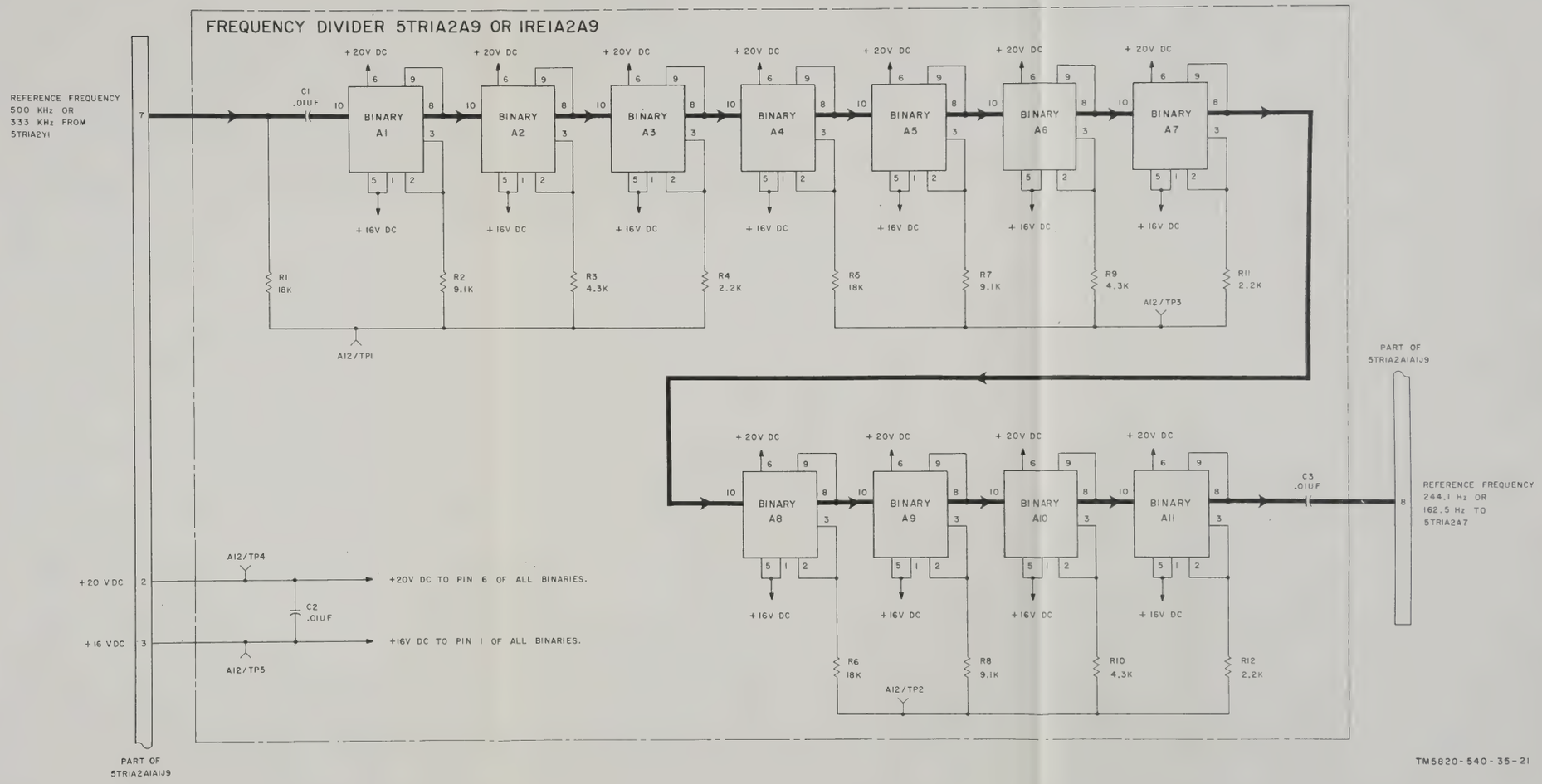
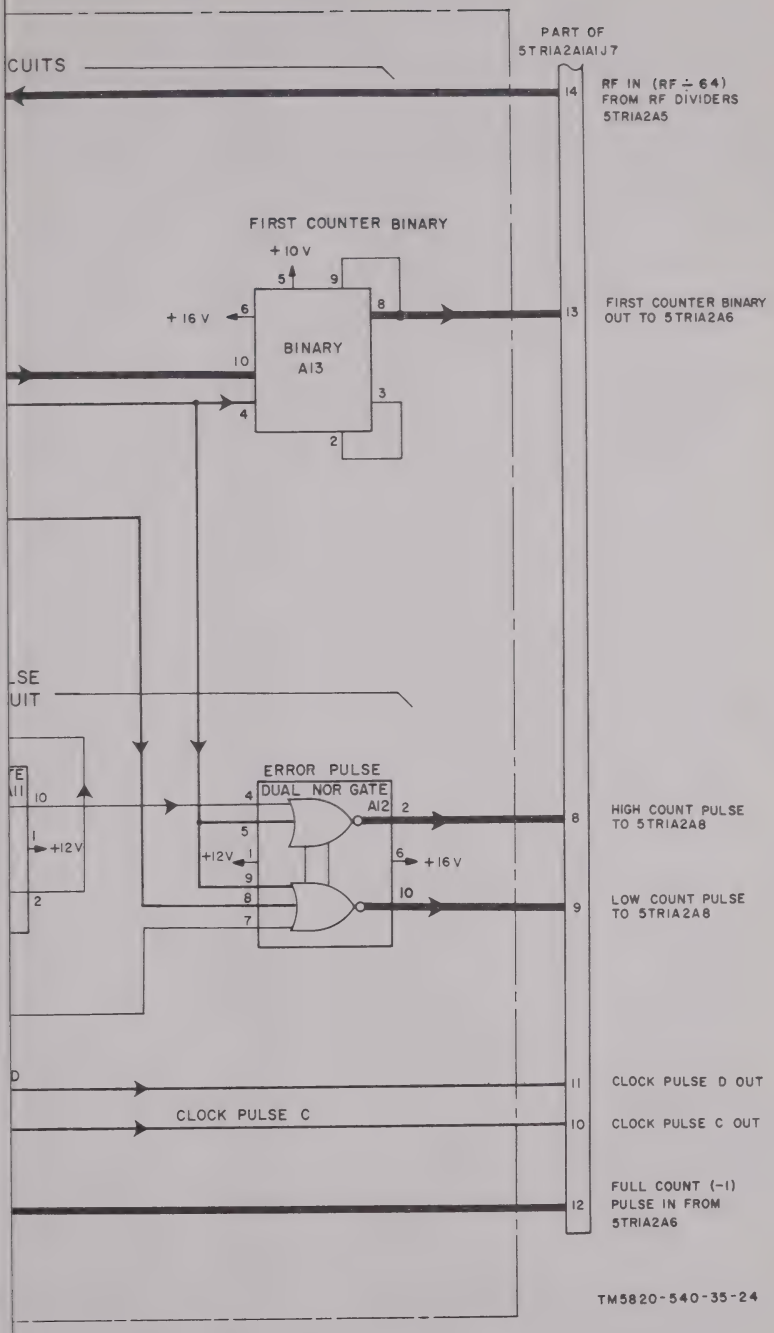


Figure 6-6. Frequency divider 5TR1A2A9 or 1RE1A2A9, schematic diagram.


PART OF
5TRIA2AIAIJ7
CUITS
14
RF IN (RF ÷ 64)
FROM RF DIVIDERS
5TRIA2A5
FIRST COUNTER BINARY
+10 V
5
9
6
+16 V
8
13
FIRST COUNTER BINARY
OUT TO 5TRIA2A6
BINARY
A13
10
3
4
2
LSE
UIT
ERROR PULSE
DUAL NOR GATE
A12
4
2
8
HIGH COUNT PULSE
TO 5TRIA2A8
5
+12V
1
6
+16 V
9
10
8
7
9
LOW COUNT PULSE
TO 5TRIA2A8
+12V
10
1
2
D
11
CLOCK PULSE D OUT
CLOCK PULSE C
10
CLOCK PULSE C OUT
FULL COUNT (-1)
PULSE IN FROM
5TRIA2A6
12
TM5820-540-35-24

NOTES

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. MAJOR FUNCTIONAL FLOW
CLOCK PULSE FLOW
SECONDARY FUNCTIONAL FLOW

3. THE VOLTAGES SHOWN ARE THOSE USED IN THE TRANSMITTER. FOR RECEIVER CONVERT AS FOLLOWS:

TRANSMITTER	RECEIVER
+ 16 V DC	+ 4 V DC
+ 12 V DC	0V
+ 10 V DC	— 2 V DC
0V	— 12 V DC

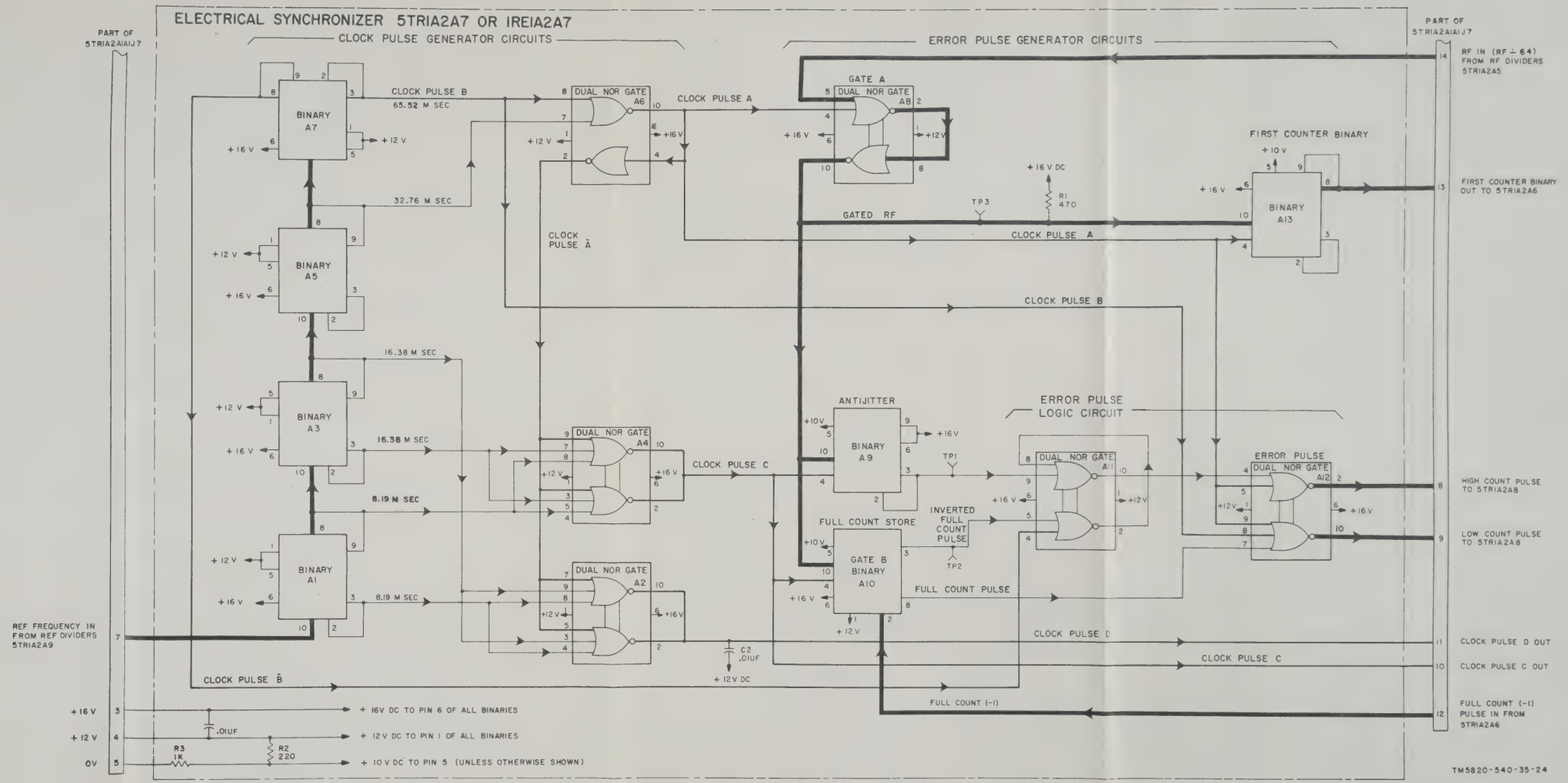
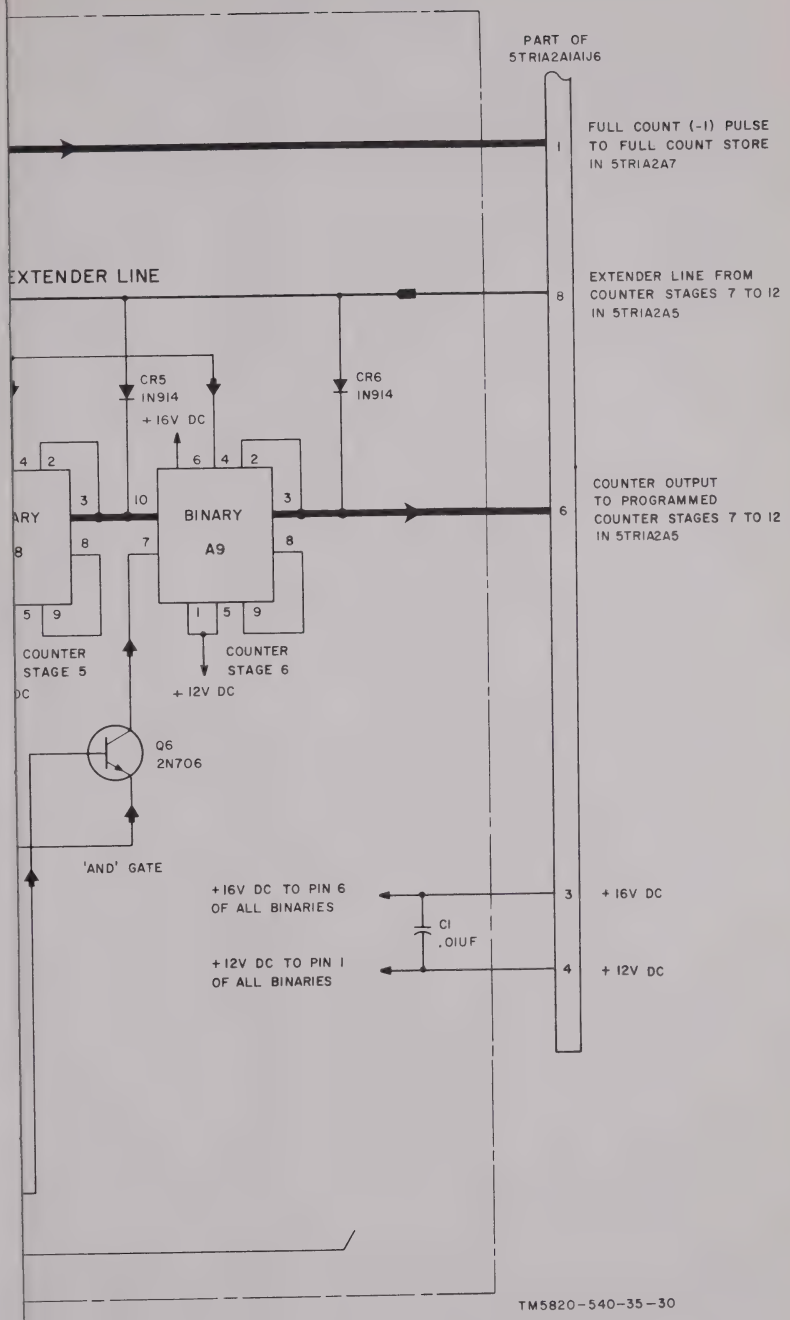


Figure 6-7. Electrical synchronizer 5TR1A2A7 or 1RE1A2A7, schematic diagram.


PART OF
5TRIA2AIAIJ6
FULL COUNT (-1) PULSE
TO FULL COUNT STORE
IN 5TRIA2A7
EXTENDER LINE
EXTENDER LINE FROM
COUNTER STAGES 7 TO 12
IN 5TRIA2A5
CR5
IN914
CR6
IN914
+16V DC
BINARY
A9
COUNTER OUTPUT
TO PROGRAMMED
COUNTER STAGES 7 TO 12
IN 5TRIA2A5
COUNTER
STAGE 5
COUNTER
STAGE 6
+12V DC
Q6
2N706
'AND' GATE
+16V DC TO PIN 6
OF ALL BINARIES
+16V DC
C1
.01UF
+12V DC TO PIN 1
OF ALL BINARIES
+12V DC
TM5820-540-35-30

NOTES

1 -

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2 -

MAJOR FUNCTIONAL FLOW

REFERENCE SIGNAL VOLTAGE

GATING SIGNAL

3 -

THE VOLTAGES SHOWN ARE THOSE USED IN THE TRANSMITTER. FOR RECEIVER CONVERT AS FOLLOWS:

TRANSMITTER.	RECEIVER.
+16V DC	+ 4V DC
+12V DC	0V

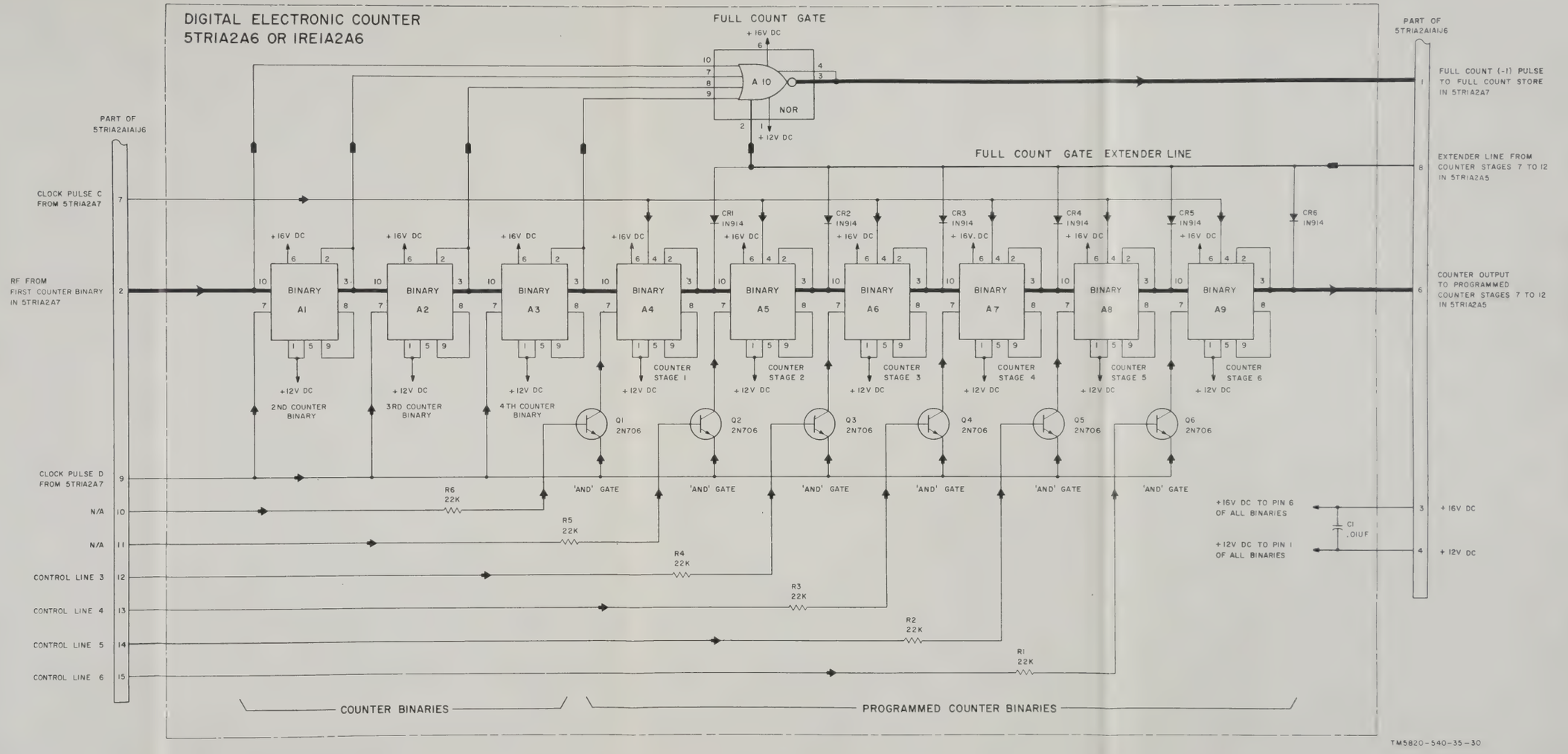
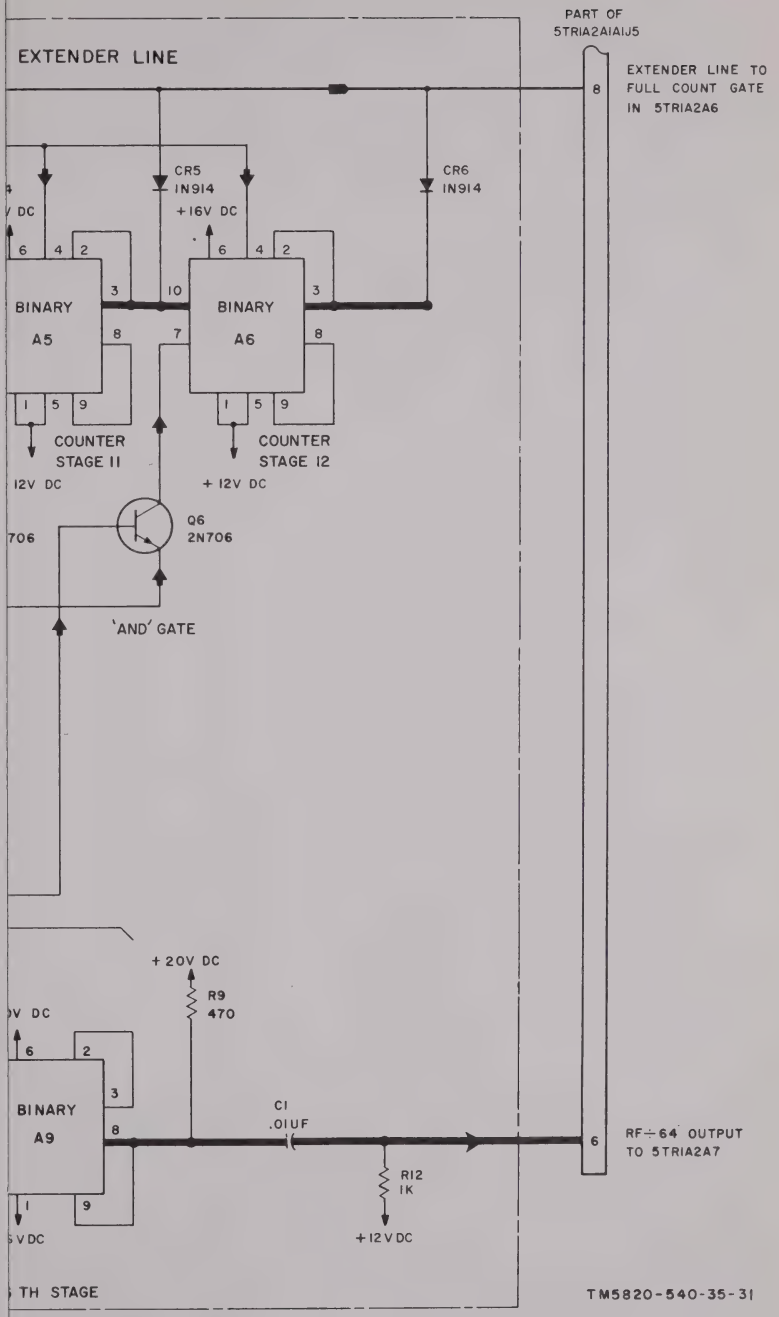


Figure 6-8. Digital electronic counter 5TR1A2A6 or 1RE1A2A6, schematic diagram.



TM5820-540-35-31

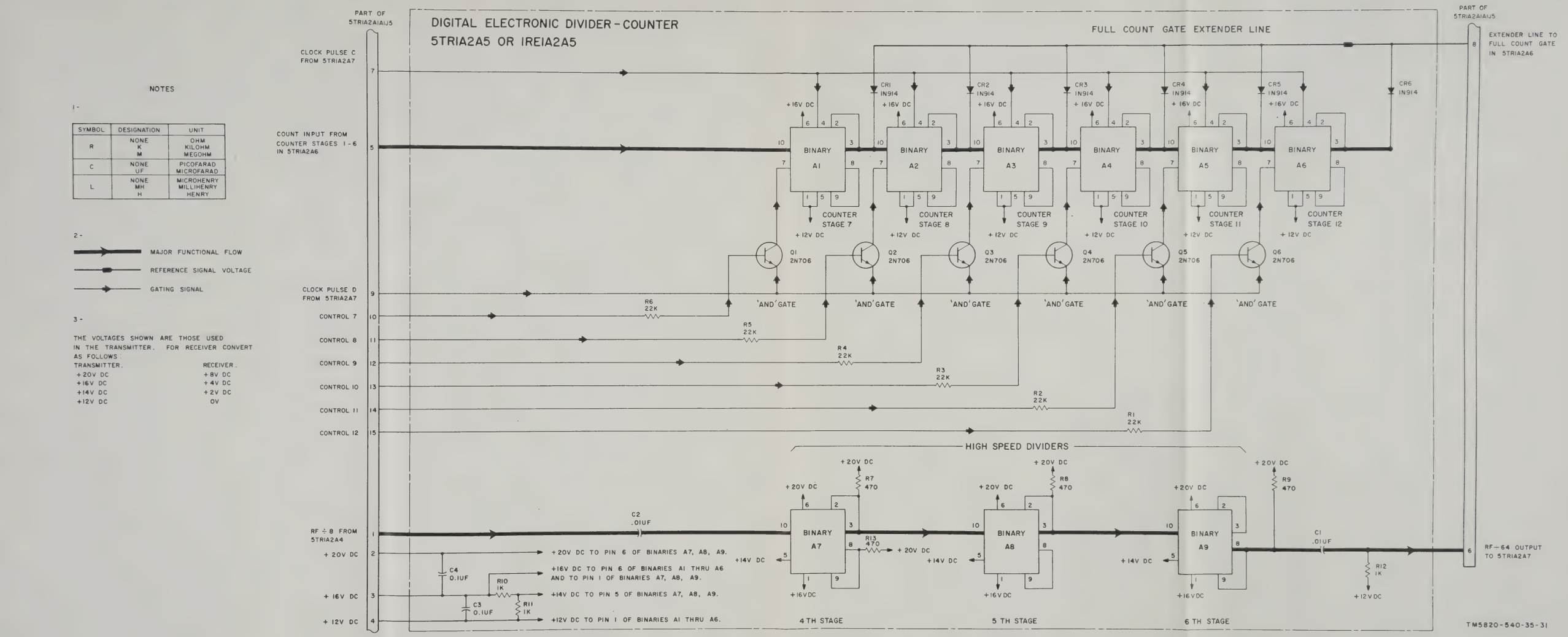
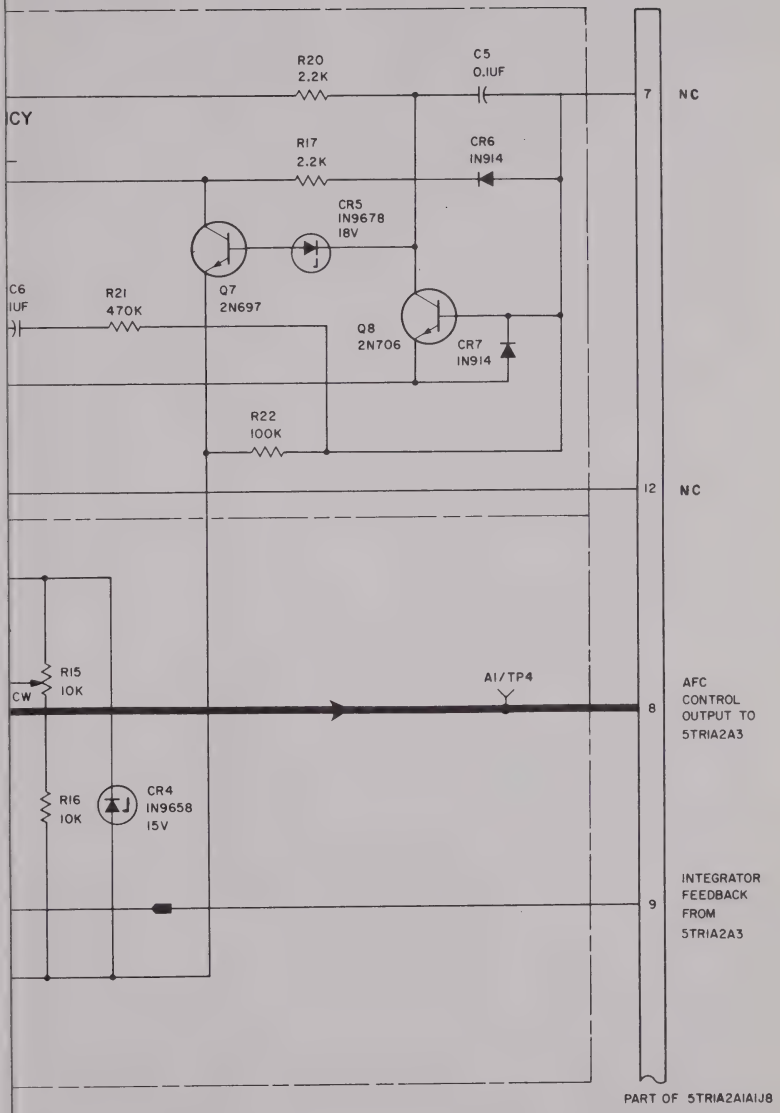


Figure 6-9. Digital electronic divider-counter 5TR1A2A5 or 1RE1A2A5, schematic diagram.



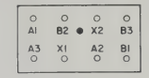
TM5820-540-35-33

NOTES

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. RELAY BASE PINS AS VIEWED FROM PIN END.



3. MAJOR FUNCTIONAL FLOW
REFERENCE SIGNAL VOLTAGE

4. THE VOLTAGES ARE THOSE USED IN THE TRANSMITTER. FOR RECEIVER CONVERT AS FOLLOWS:

TRANSMITTER	RECEIVER
+28V DC	+12V DC
+12V DC	0V
0V	-12V DC

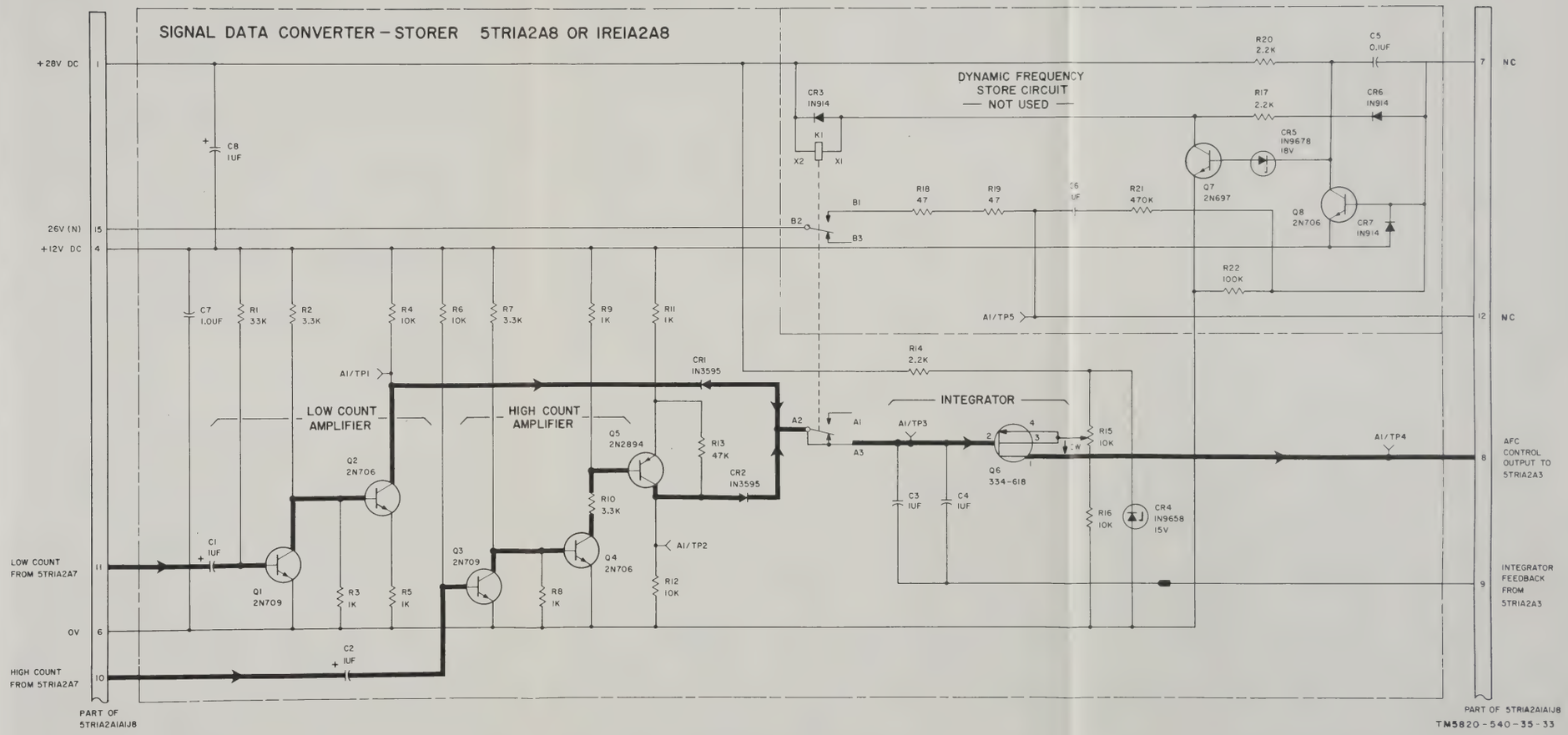
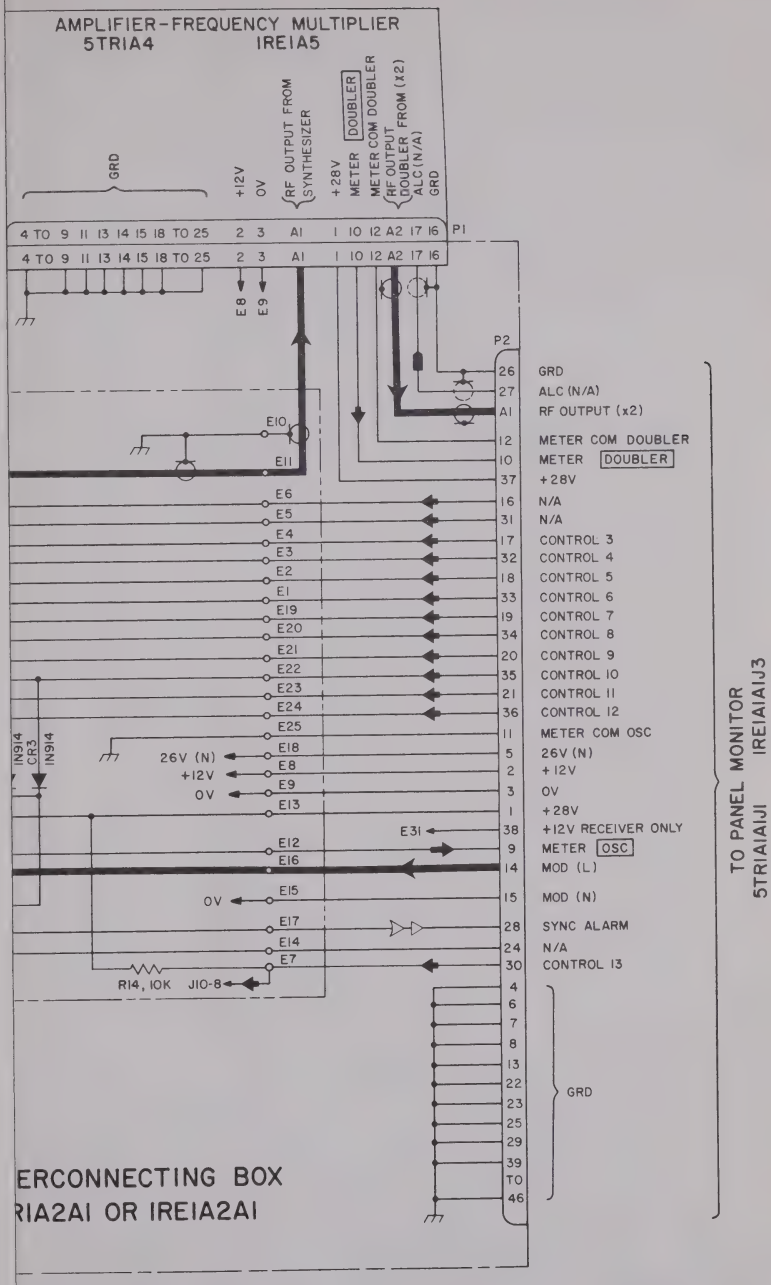


Figure 6-10. Signal data converter-storer 5TR1A2A8 or 1RE1A2A8, schematic diagram.



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NOTES

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. THE VOLTAGES SHOWN ARE THOSE USED IN THE TRANSMITTER. FOR RECEIVER CONVERT AS FOLLOWS:

TRANSMITTER	RECEIVER
0	-12V DC
+12V DC	0
+28V DC	+12V DC
+20V DC	+8V DC
+16V DC	+4V DC

3. MAJOR FUNCTIONAL FLOW
DC METERING FLOW
SECONDARY SIGNAL FLOW
FAULT SIGNAL PATH TO LIGHT LAMP OR PROVIDE INDICATION.
REFERENCE SIGNAL VOLTAGE
GATING OR SYNCHRONIZING SIGNAL

4. CONNECTORS J2 TO J10 INCL. MAY HAVE PINS INDENTIFIED BY EITHER LETTERS OR NUMERALS. THE FOLLOWING TABLE SHOWS THE EQUIVALENT IDENTIFICATIONS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	B	C	D	E	F	H	J	K	L	M	N	P	R	S

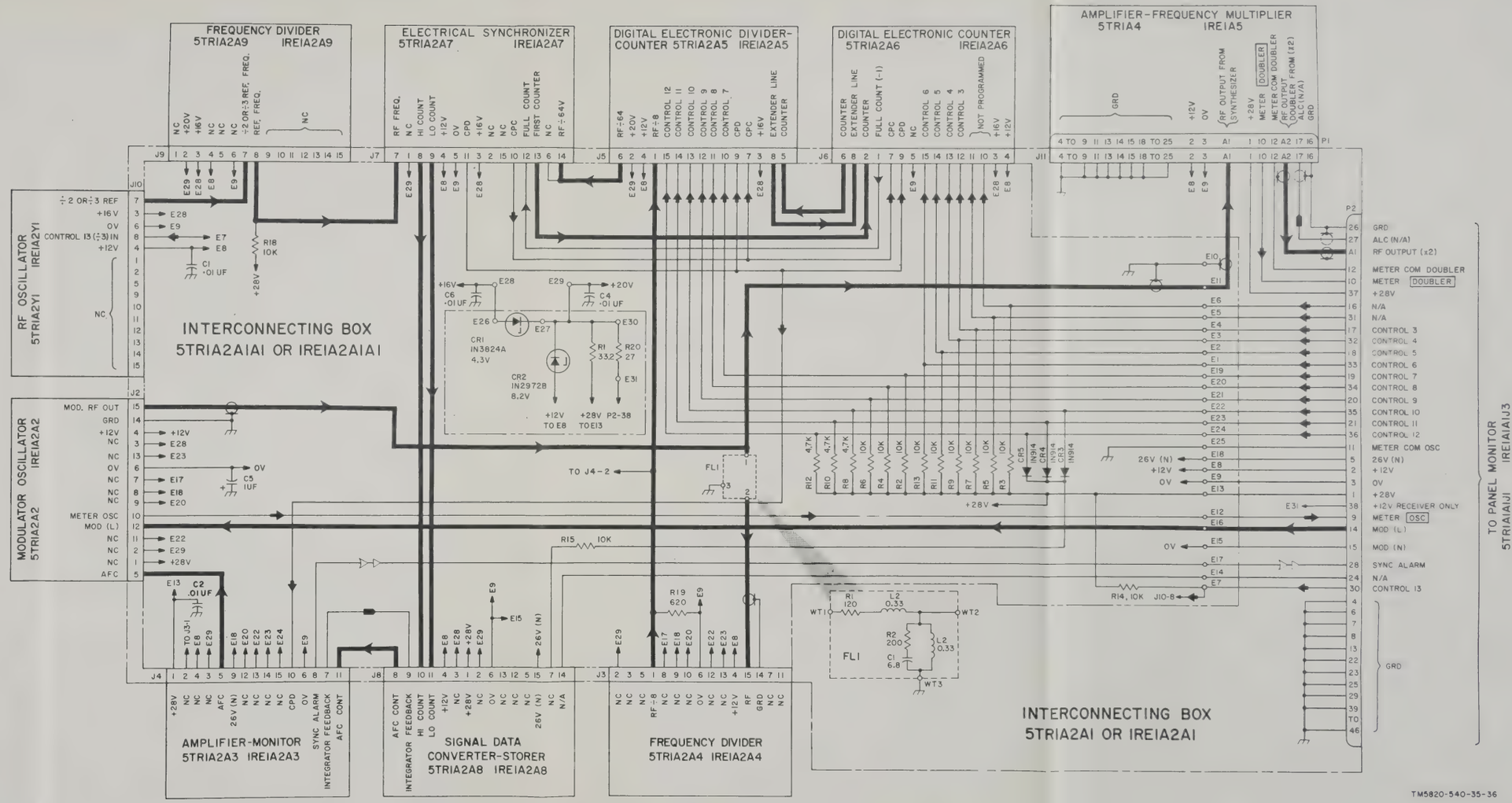
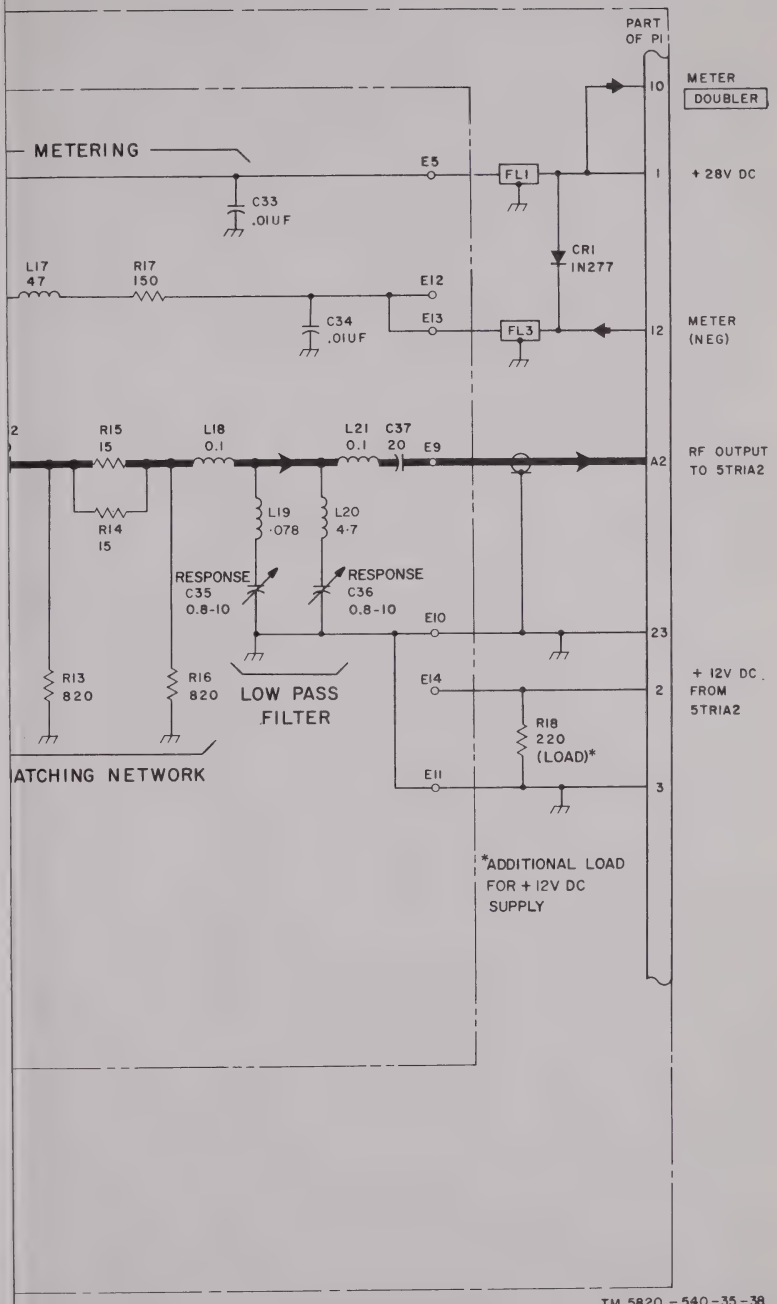


Figure 6-11. Interconnecting box 5TR1A2A1 or 1RE1A2A1, schematic diagram.


PART OF P1
METER DOUBLER
10
METERING
E5
FL1
1
+28V DC
C33 .01UF
CR1 IN277
L17 47
R17 150
E12
C34 .01UF
E13
FL3
12
METER (NEG)
2
R15 15
L18 0.1
L21 0.1
C37 20
E9
A2
RF OUTPUT TO 5TRIA2
R14 15
L19 .078
L20 4.7
RESPONSE C35 0.8-10
RESPONSE C36 0.8-10
E10
23
R13 820
R16 820
LOW PASS FILTER
E14
2
+12V DC FROM 5TRIA2
R18 220 (LOAD)*
ATCHING NETWORK
E11
3
*ADDITIONAL LOAD FOR +12V DC SUPPLY
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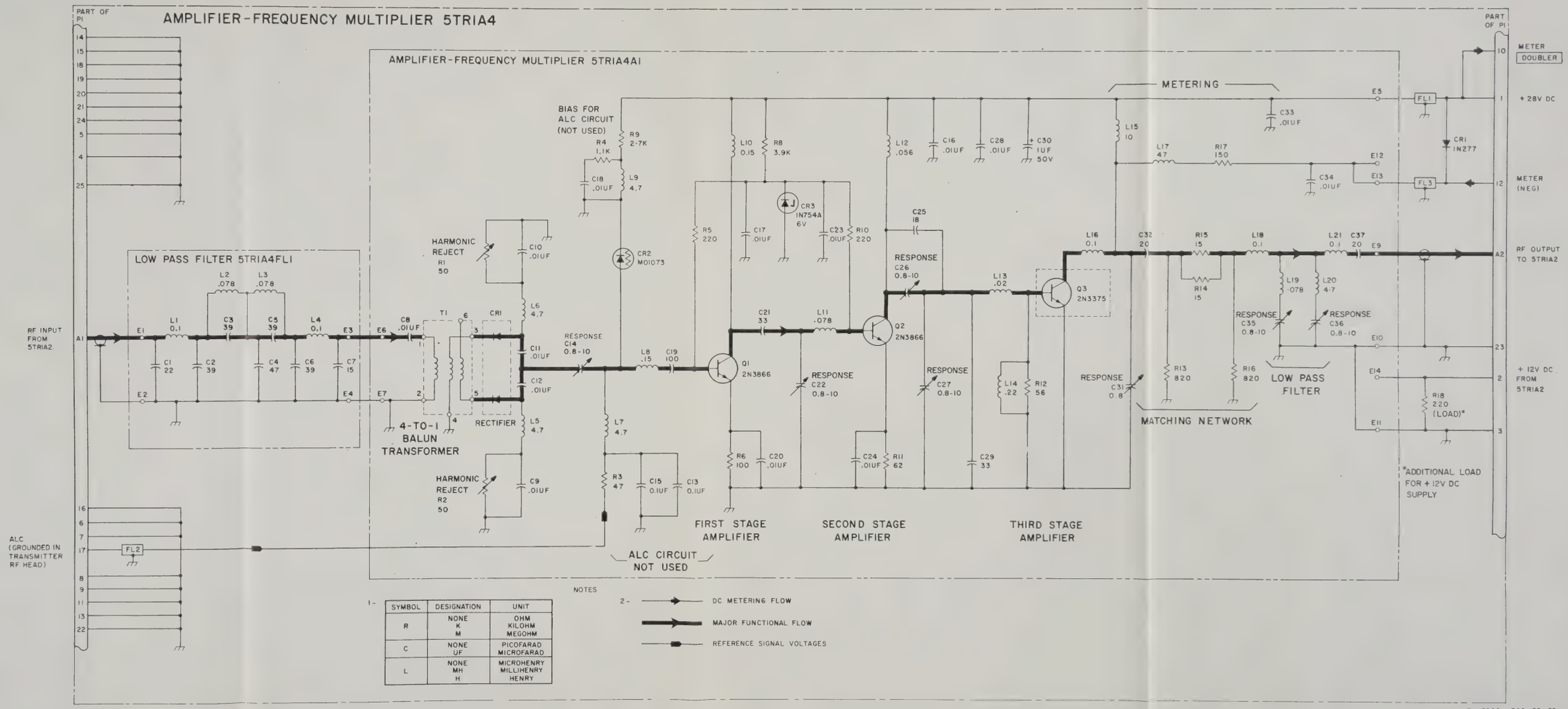
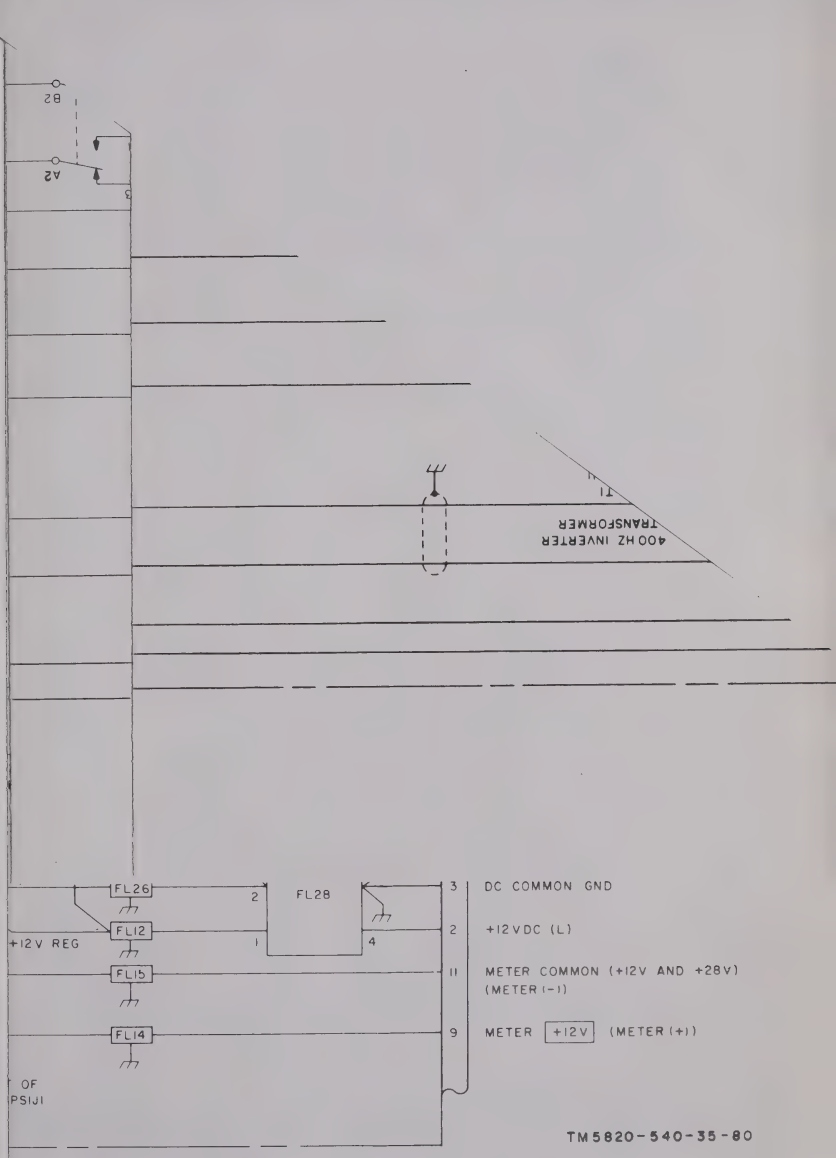


Figure 6-12. Amplifier-frequency multiplier 5TR1A4, schematic diagram.



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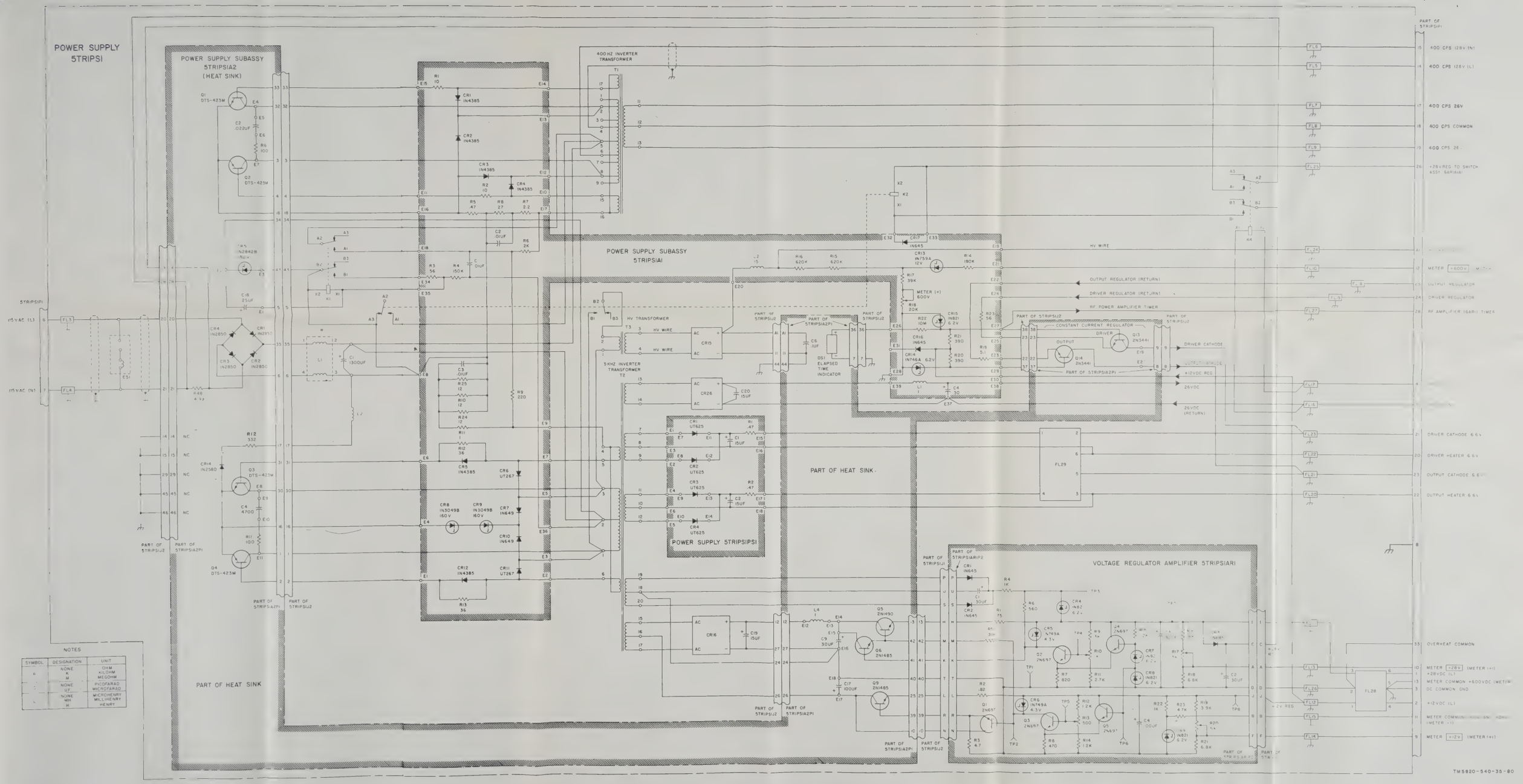
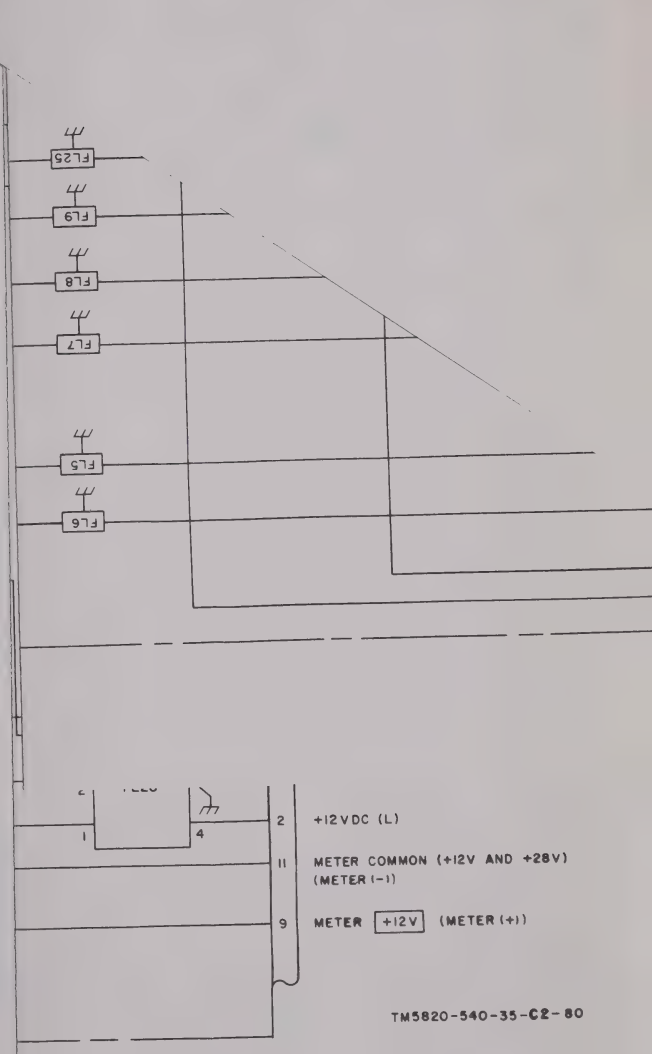


TM5820-540-35-80

Figure 6-13. Power supply 5TRIPS1, schematic wiring diagram.



PS1, schematic-wiring diagram, as modified
) 11-5820-540-40/1.

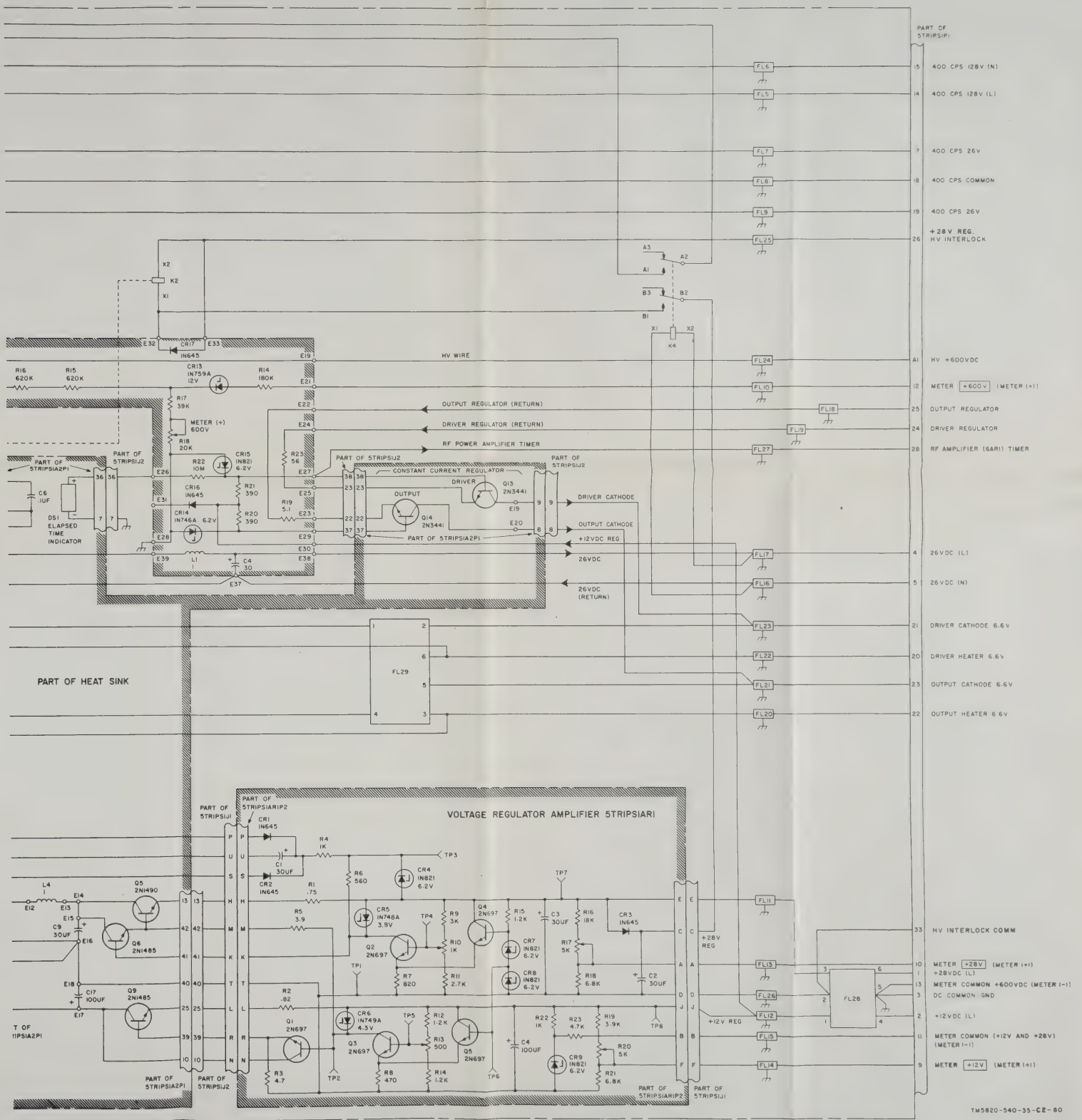


Figure 6-13.1. Power supply 5TR1PS1, schematic-wiring diagram, as modified by MWO 11-5820-540-40/1.

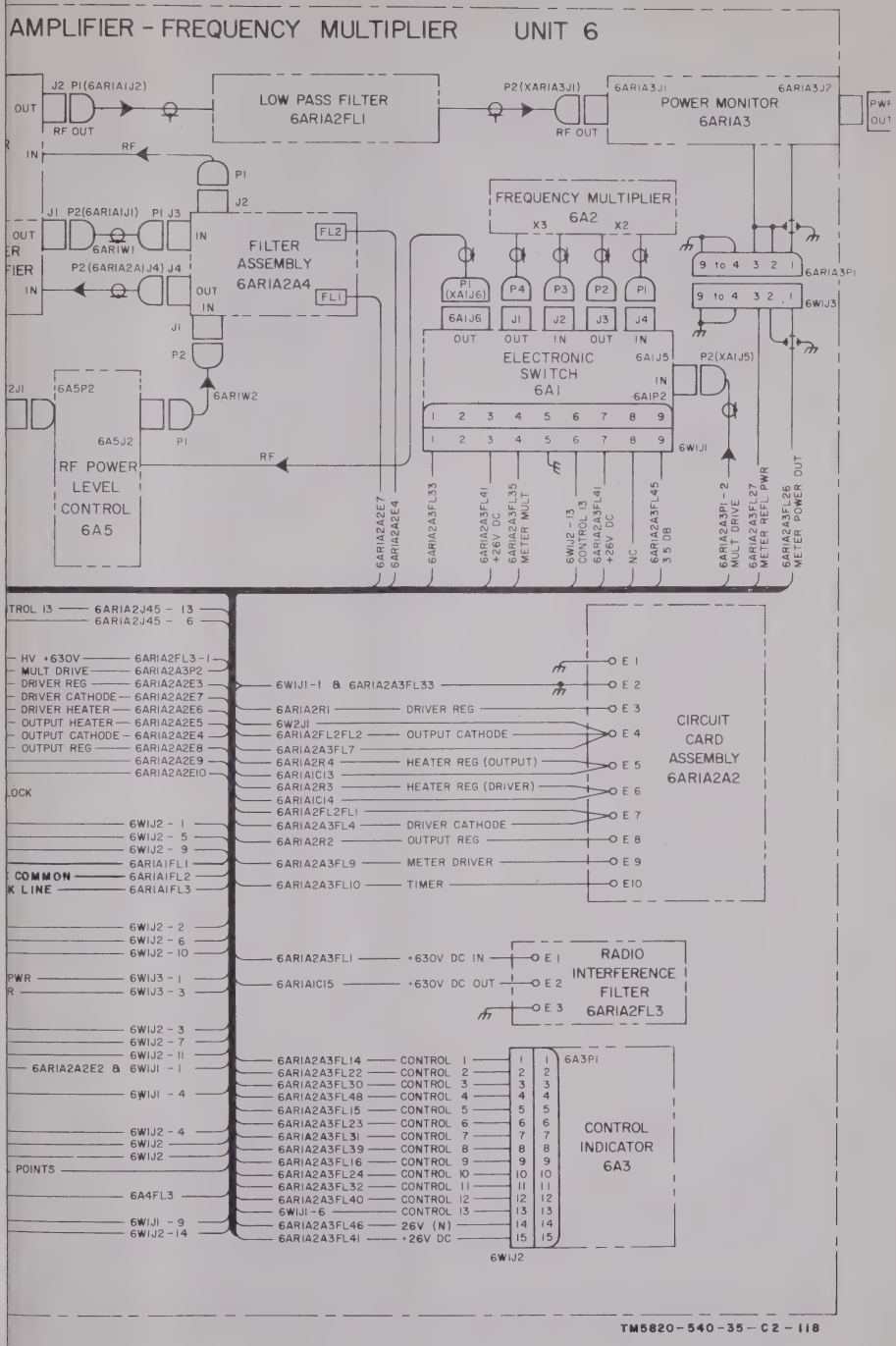


Figure 6-14. Transmitter, Radio T-983(P)/GRC-103 (V) and Amplifier-Frequency Multiplier AM-4320/GRC-103(V), interconnection diagram.

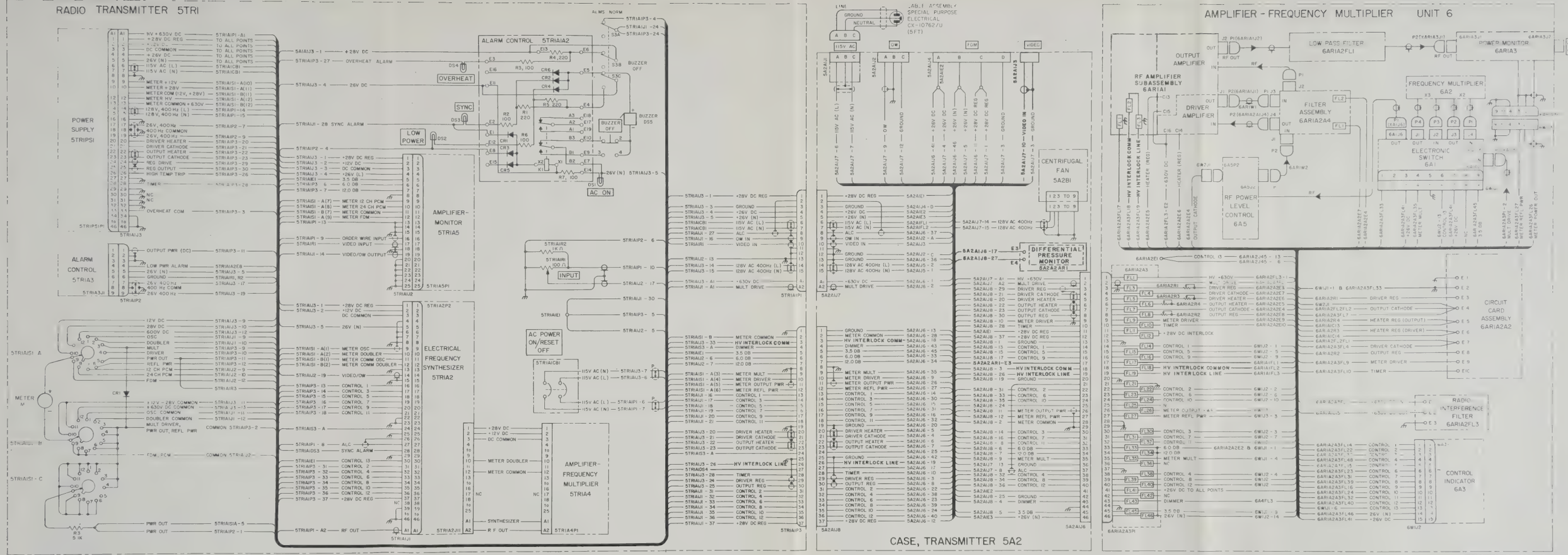
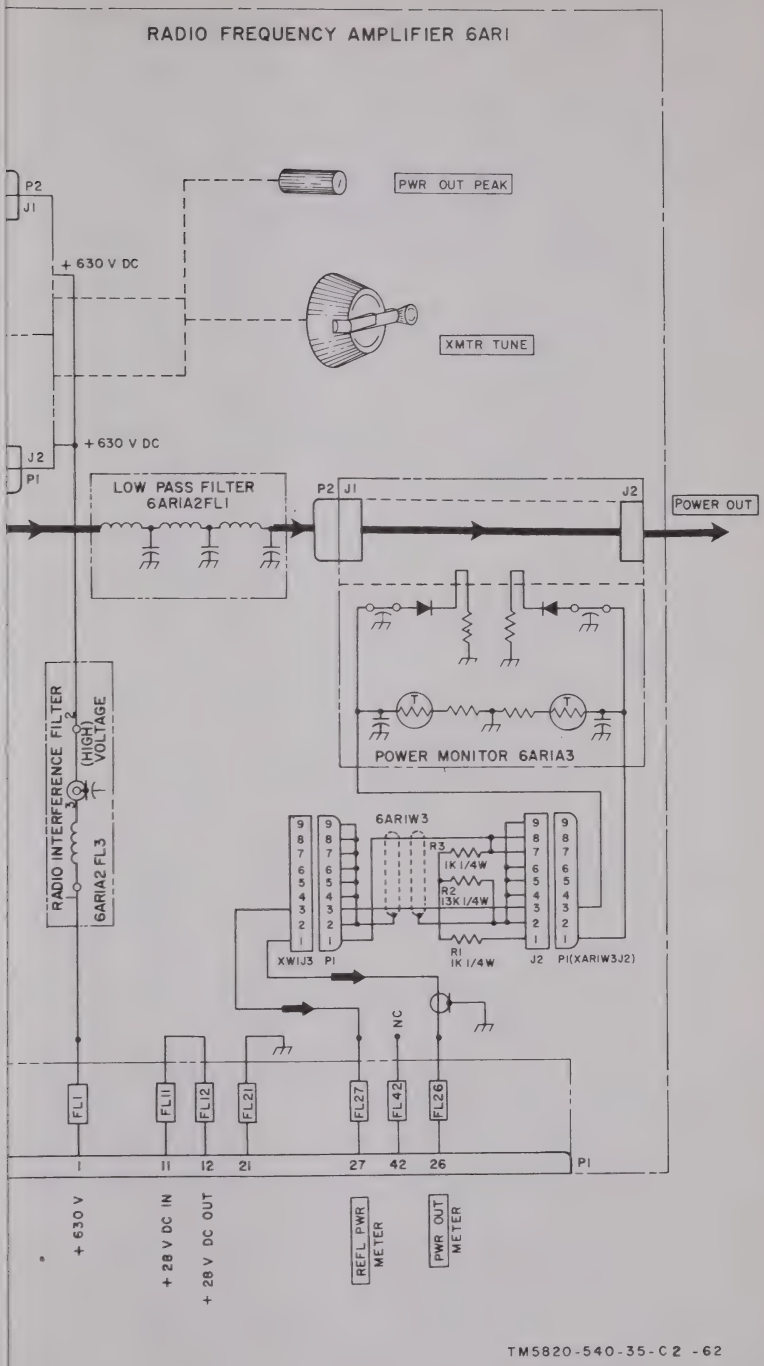


Figure 6-14. Transmitter, Radio T-983(P)/GRC-103(V) and Amplifier-Frequency Multiplier AM-4320/GRC-103(V), interconnection diagram.



fier-Frequency Multiplier AM-4320/GRC-103(V), schematic diagram.

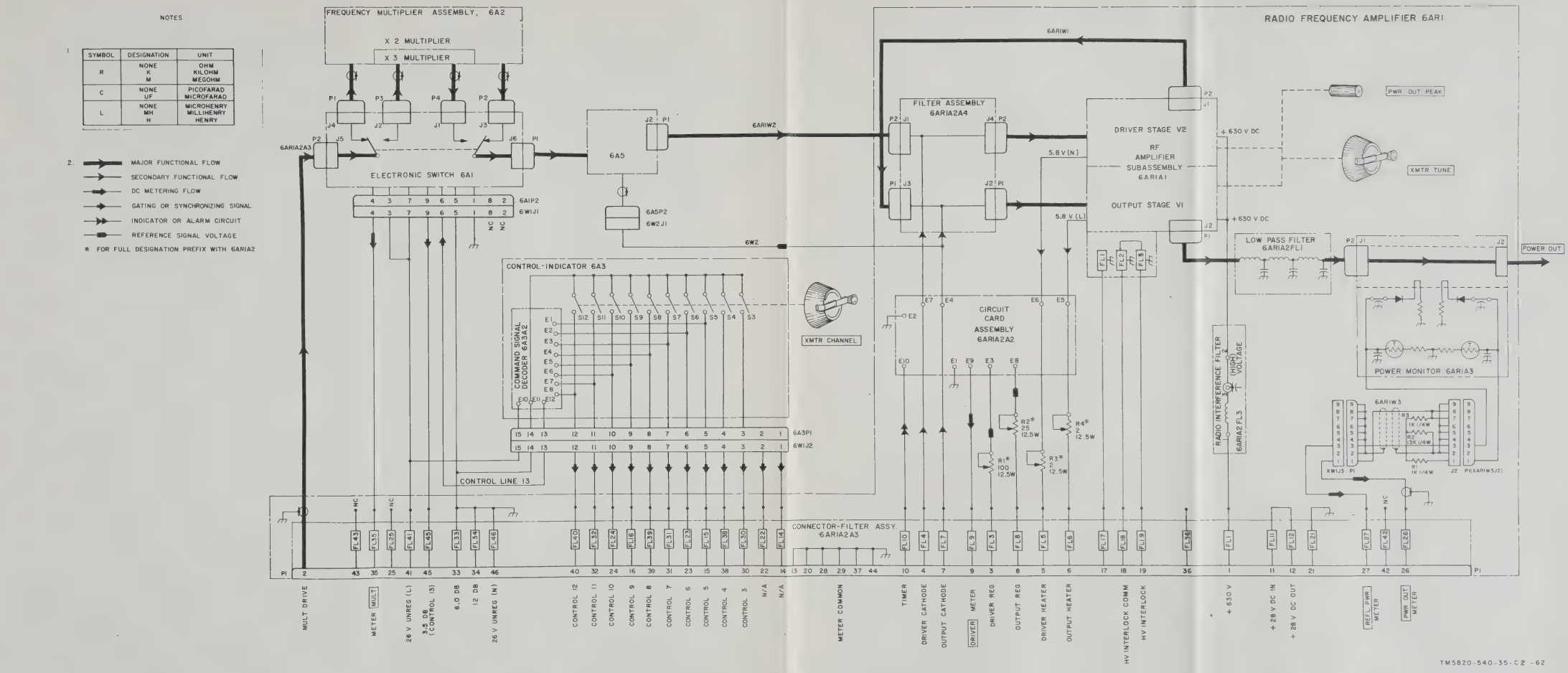
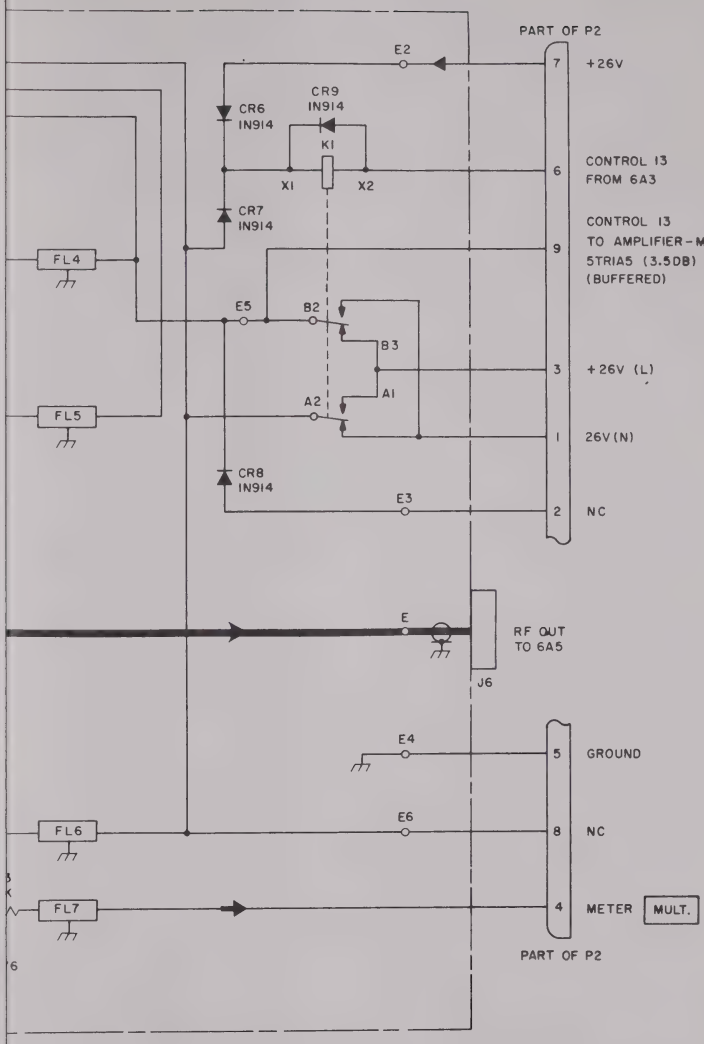


Figure 6-15. Amplifier-Frequency Multiplier AM-4320/GRC-103(V), schematic diagram.


PART OF P2
E2
7
+26V
CR9
IN914
CR6
IN914
K1
6
CONTROL 13
FROM 6A3
X1
X2
CR7
IN914
CONTROL 13
TO AMPLIFIER-MONITOR
5TRIA5 (3.5DB)
(BUFFERED)
9
FL4
E5
B2
B3
3
+26V (L)
A1
A2
FL5
1
26V(N)
CR8
IN914
E3
2
NC
E
RF OUT
TO 6A5
J6
E4
5
GROUND
E6
FL6
8
NC
FL7
4
METER
MULT.
PART OF P2

NOTES

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. MAJOR FUNCTIONAL FLOW
DC METERING FLOW
GATING OR SYNCRONIZING SIGNAL
SIGNAL PATH TO ENERGIZE RELAY

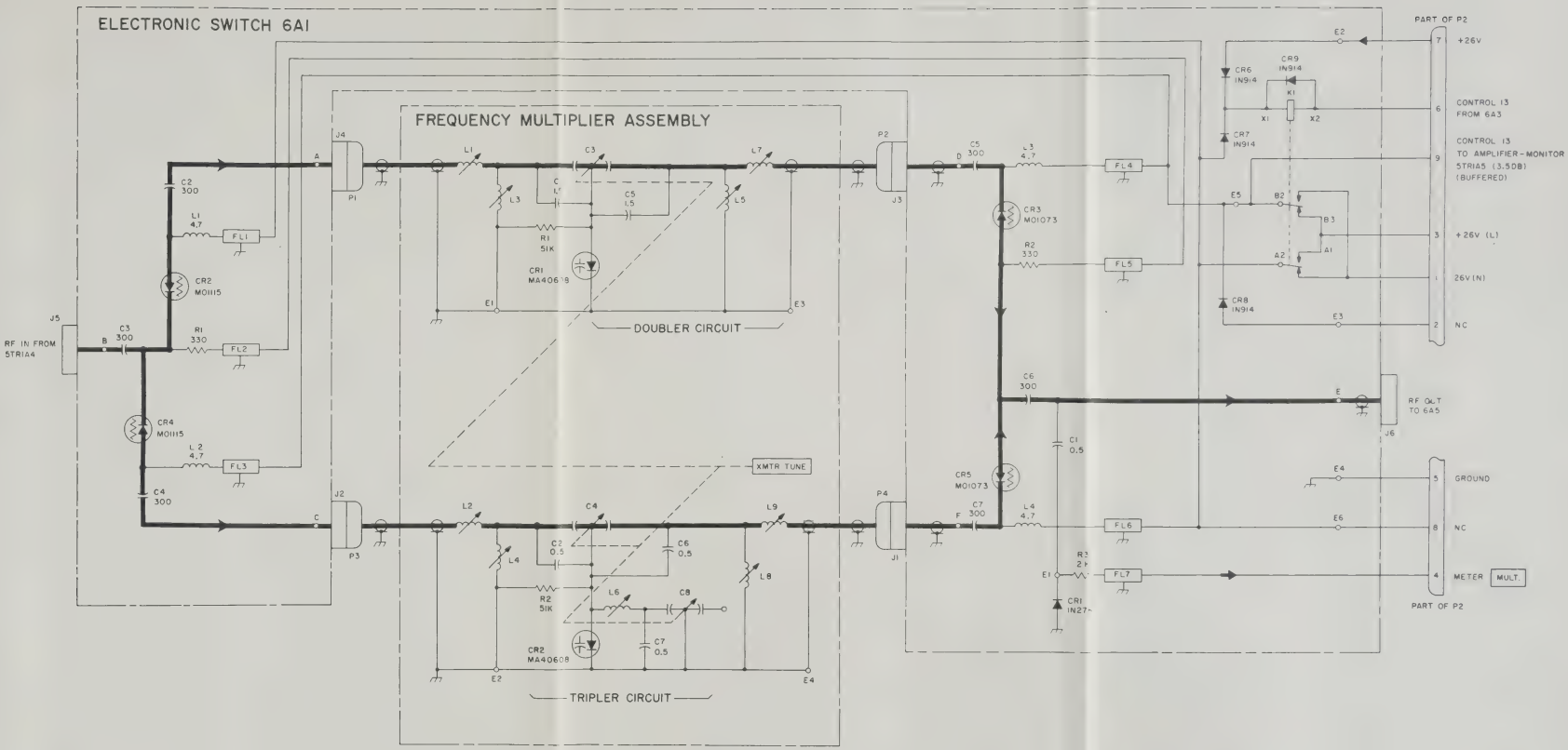


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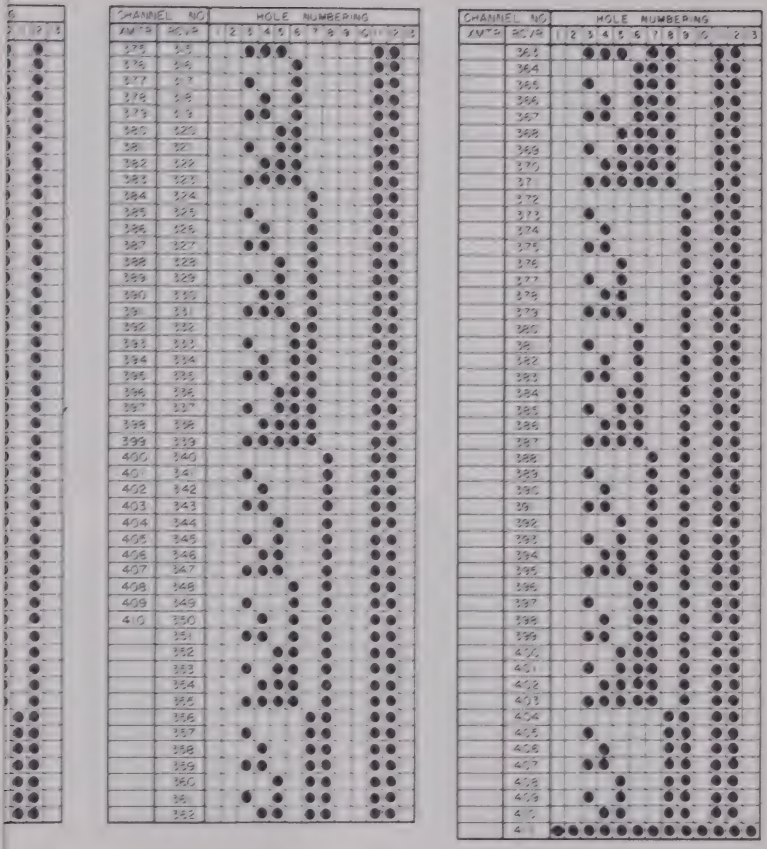
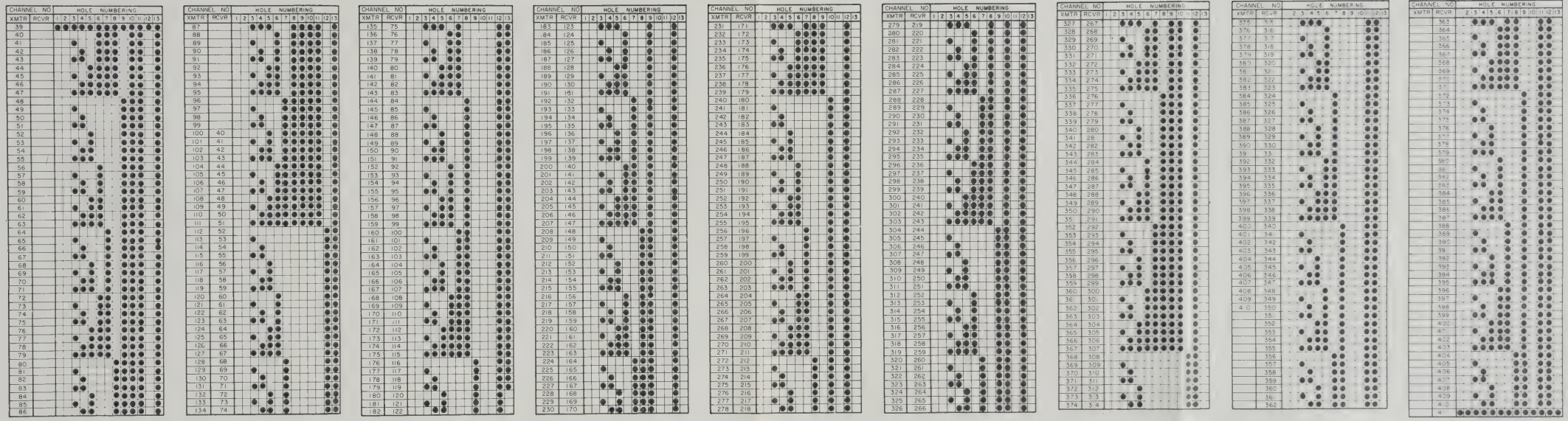
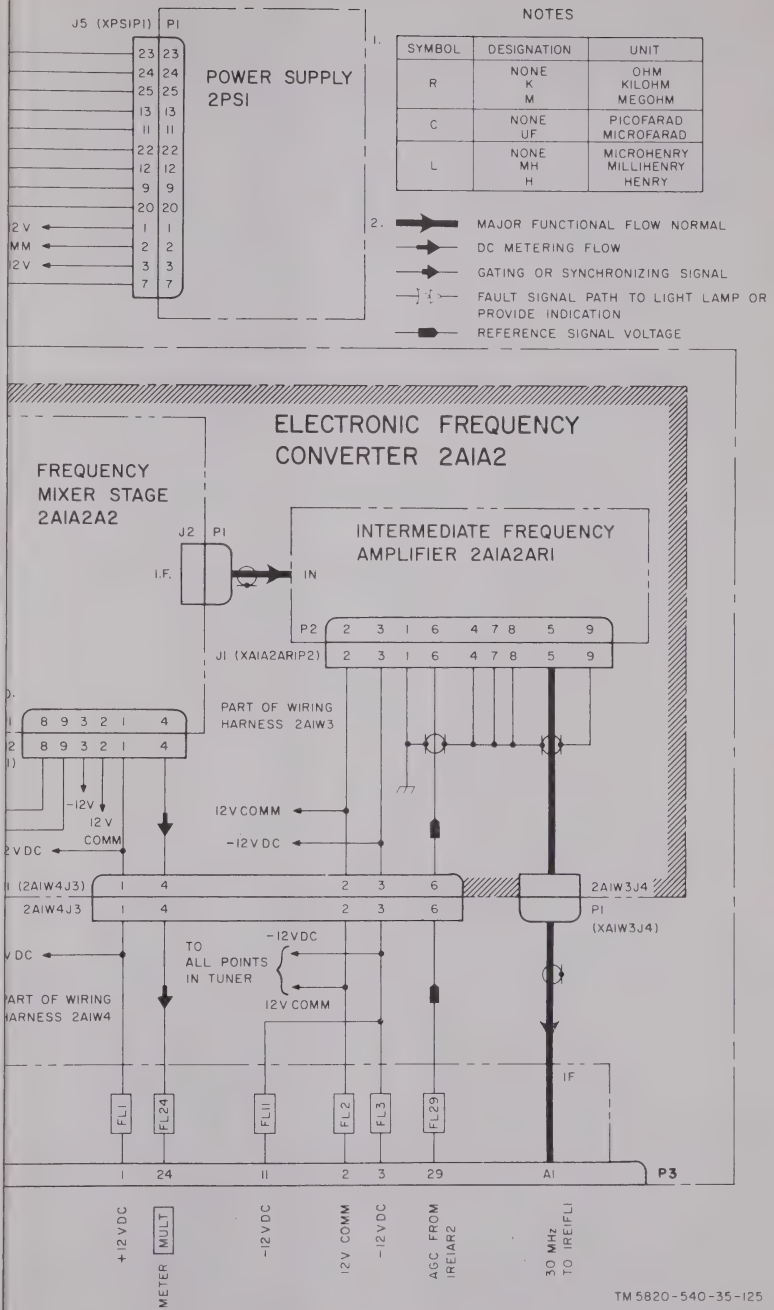
Figure 6-16. Electronic switch 6A1 and frequency multiplier assembly 6A2, schematic diagram.



TM5820-540-35-58



TM5820-540-35-58



TM 5820-540-35-125

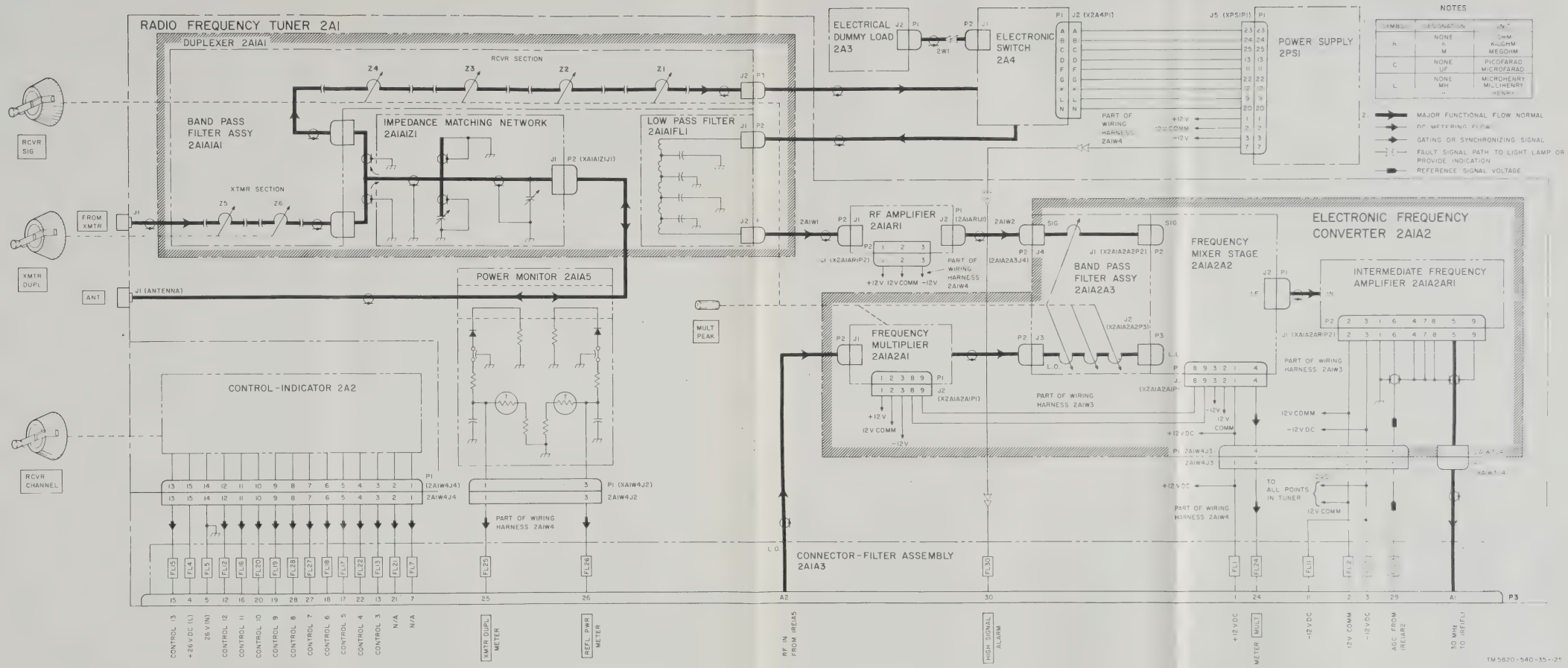
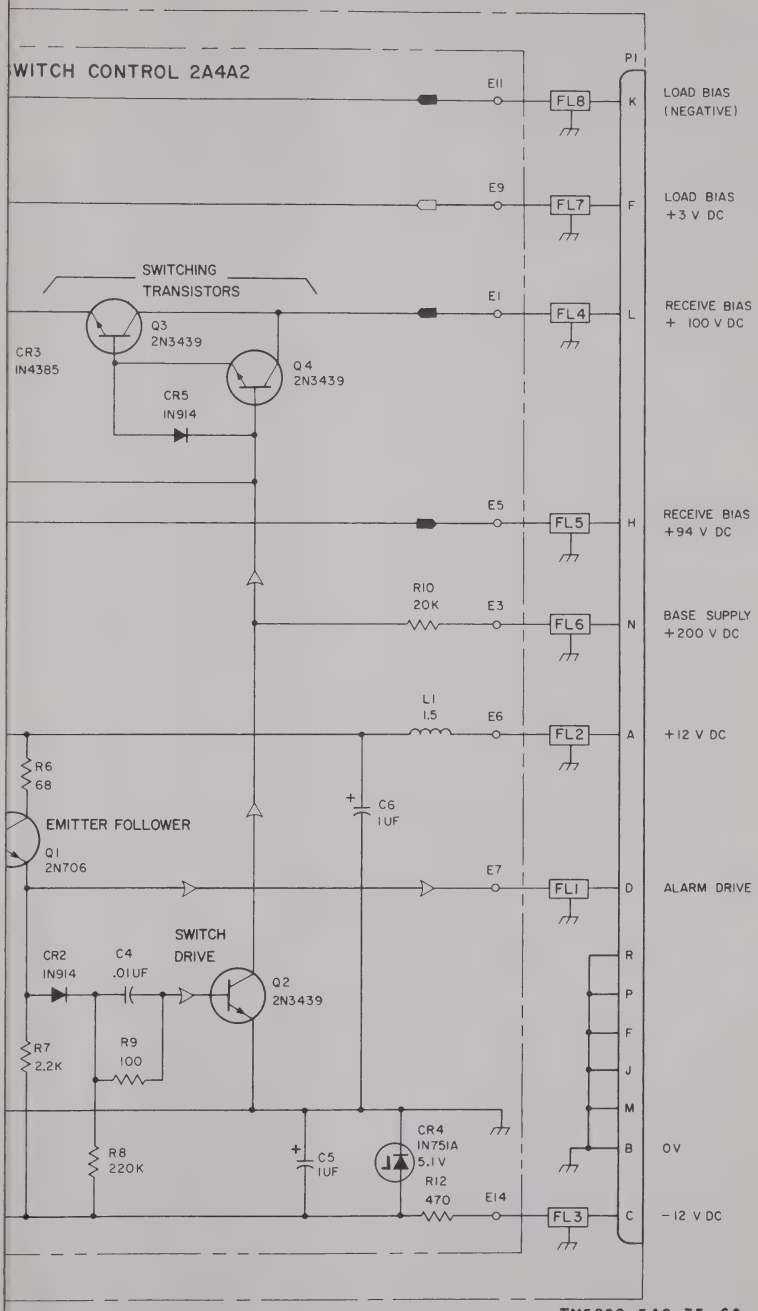


Figure 6-18. Receiver rf head, schematic diagram.



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NOTES

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. STRIPLINE

3. MAJOR FUNCTIONAL FLOW.
MAJOR FUNCTIONAL FLOW FAULT CONDITION.
SECONDARY FUNCTIONAL FLOW FAULT CONDITION.
REFERENCE SIGNAL VOLTAGE.
REFERENCE SIGNAL VOLTAGE FAULT CONDITION.

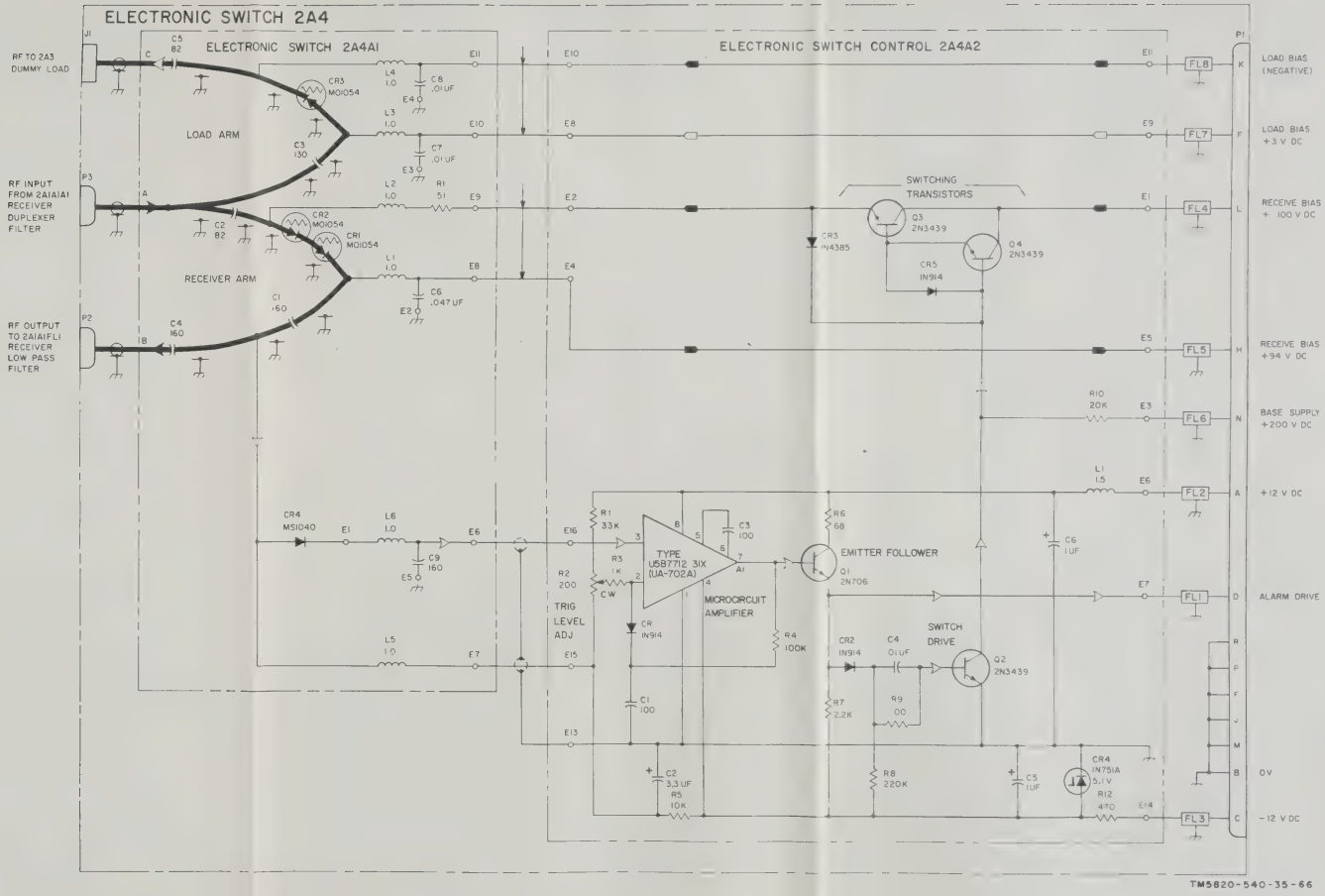
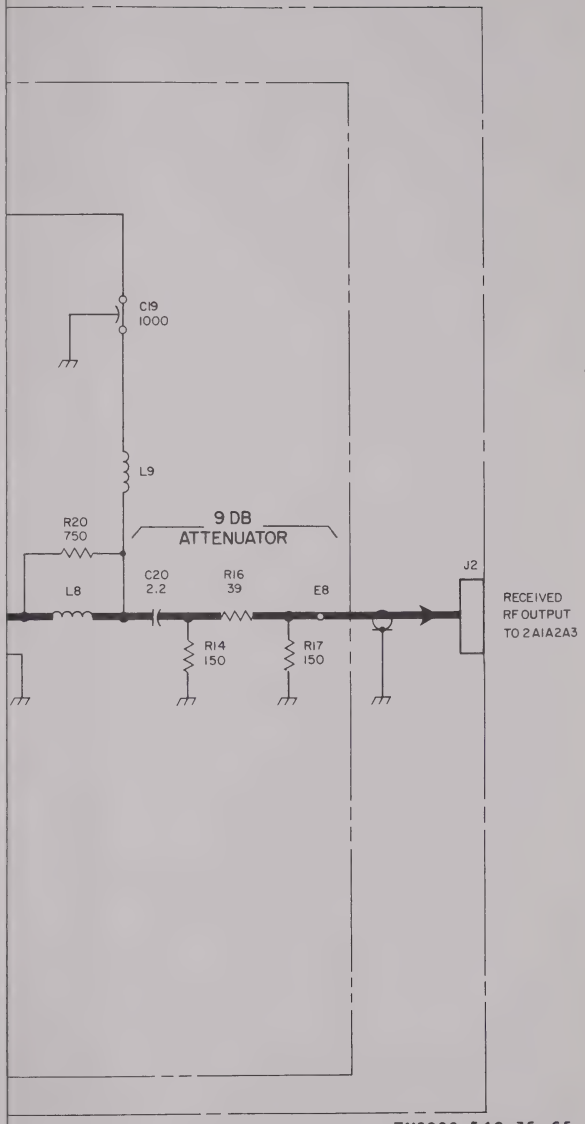


Figure 6-19. Electronic switch 2A4, schematic diagram.



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NOTES:

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. ➔ MAJOR FUNCTIONAL FLOW

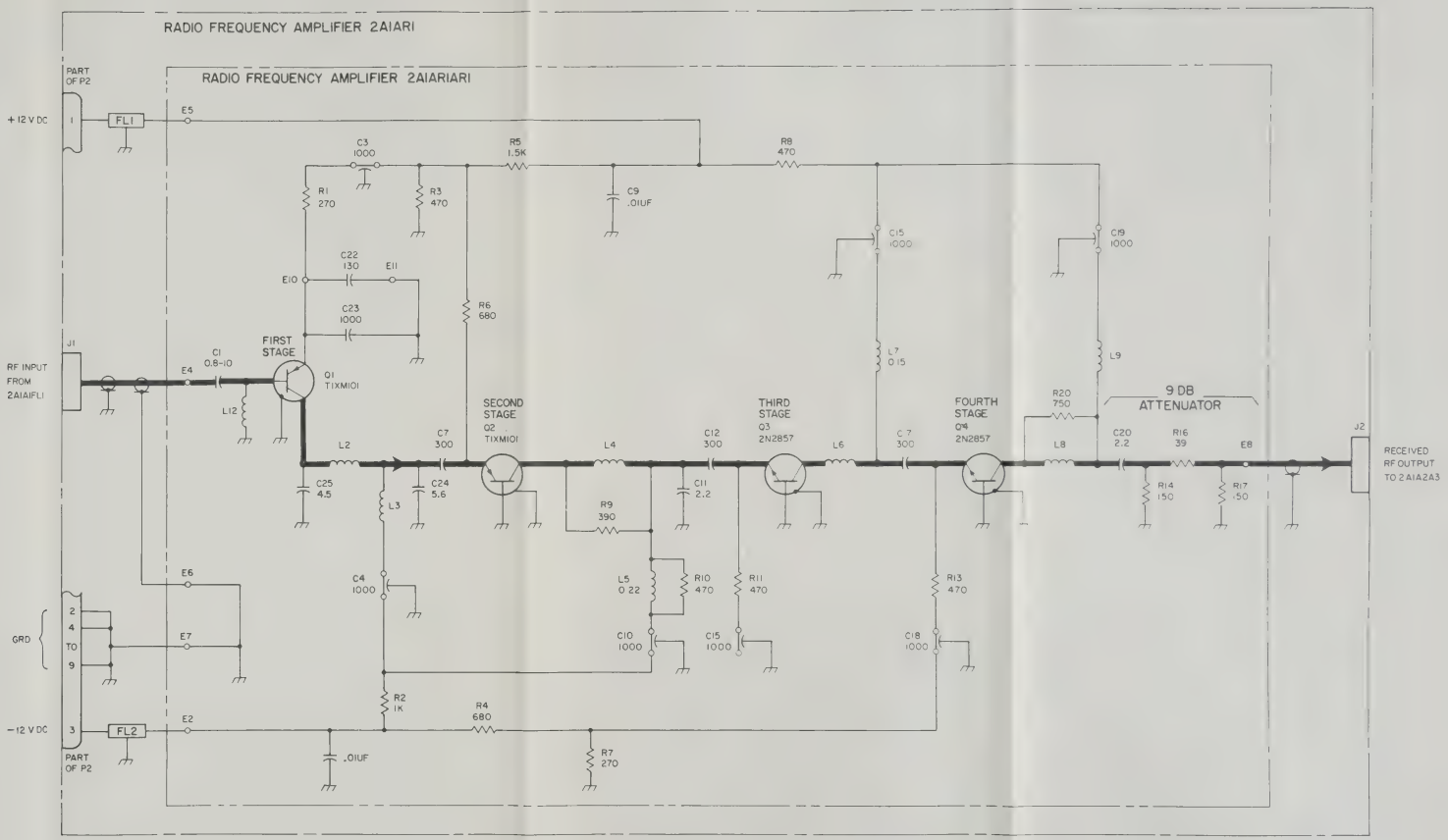
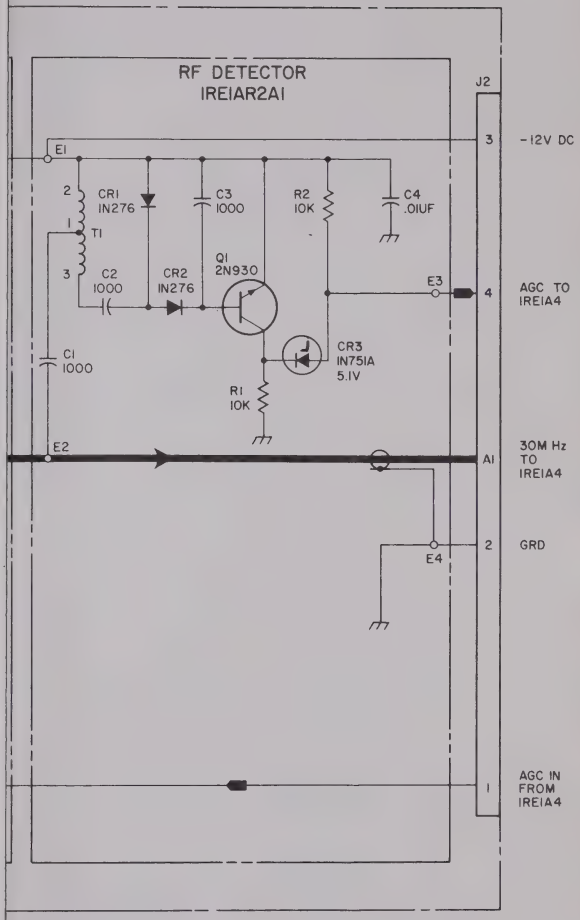


Figure 6-20. Radiofrequency amplifier 2A1AR1, schematic diagram.



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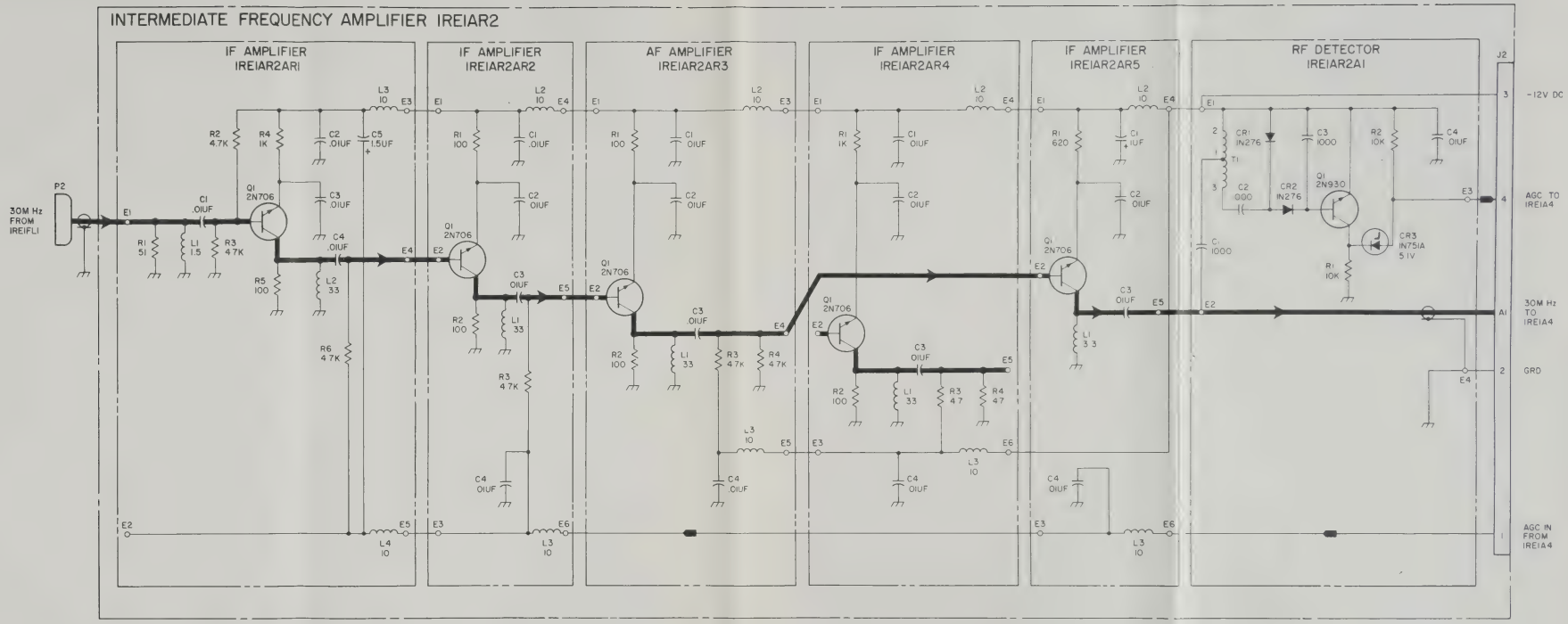


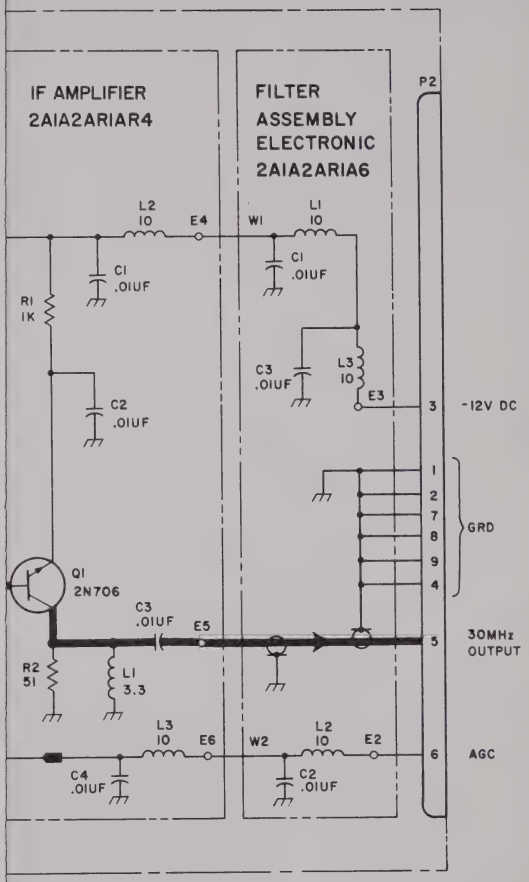
NOTES

1-

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2- MAJOR FUNCTIONAL FLOW NORMAL
REFERENCE SIGNAL VOLTAGE

Figure 6-22. Intermediate frequency amplifier 1RE1AR2, schematic diagram.



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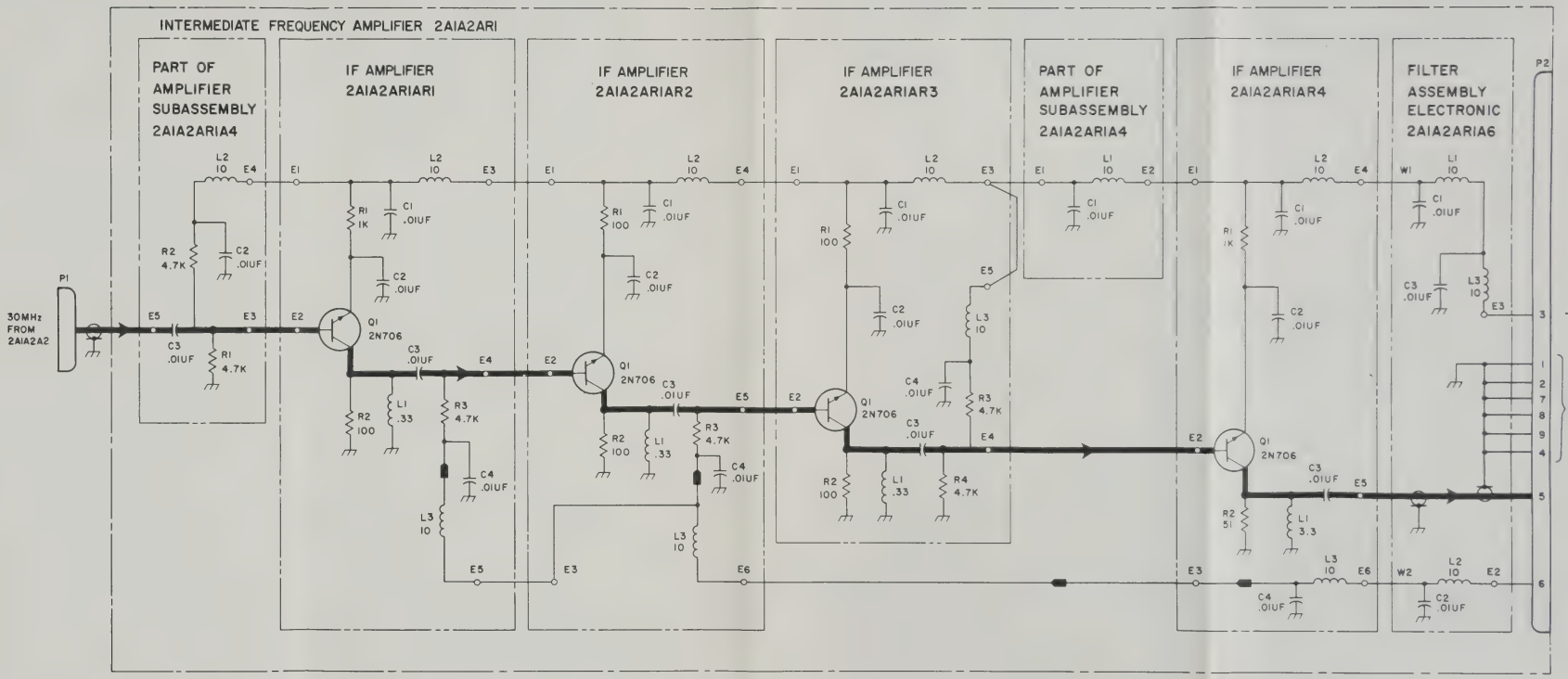

NOTES:

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. MAJOR FUNCTIONAL FLOW

3. REFERENCE SIGNAL VOLTAGE (AGC)

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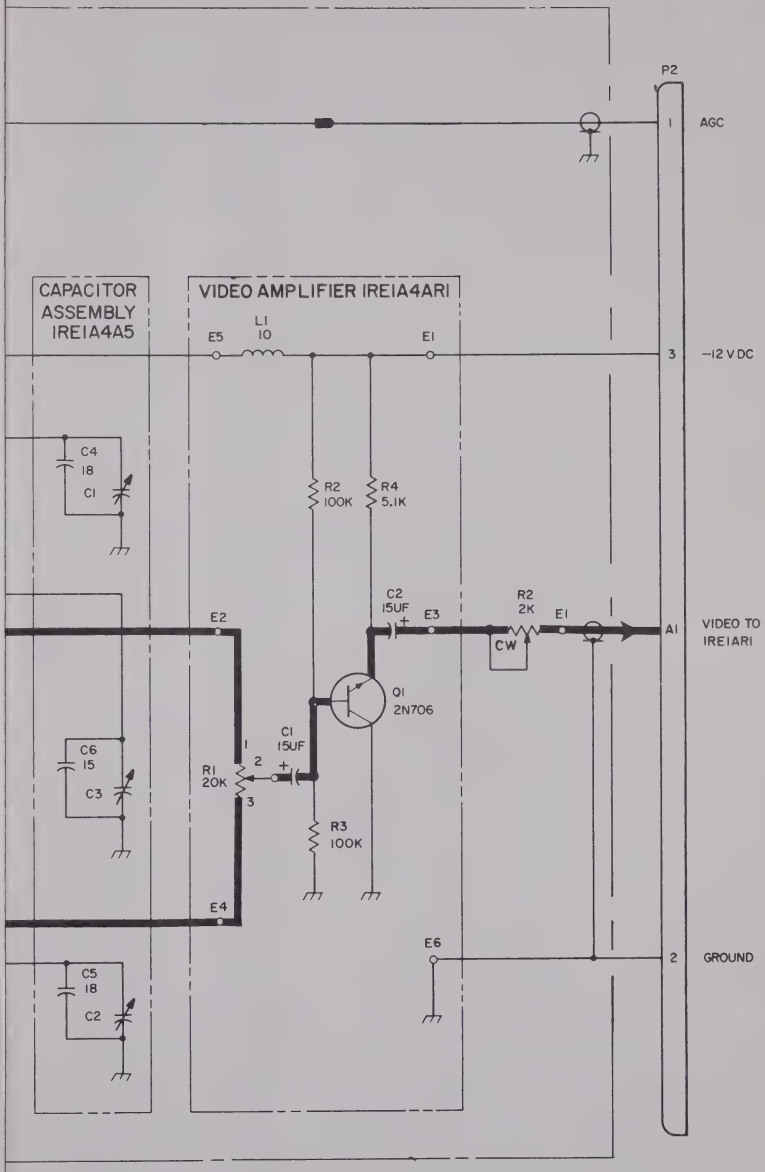
Figure 6-21. Intermediate frequency amplifier 2A1A2AR1, schematic diagram



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NOTES

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. MAJOR FUNCTIONAL FLOW

REFERENCE SIGNAL VOLTAGE

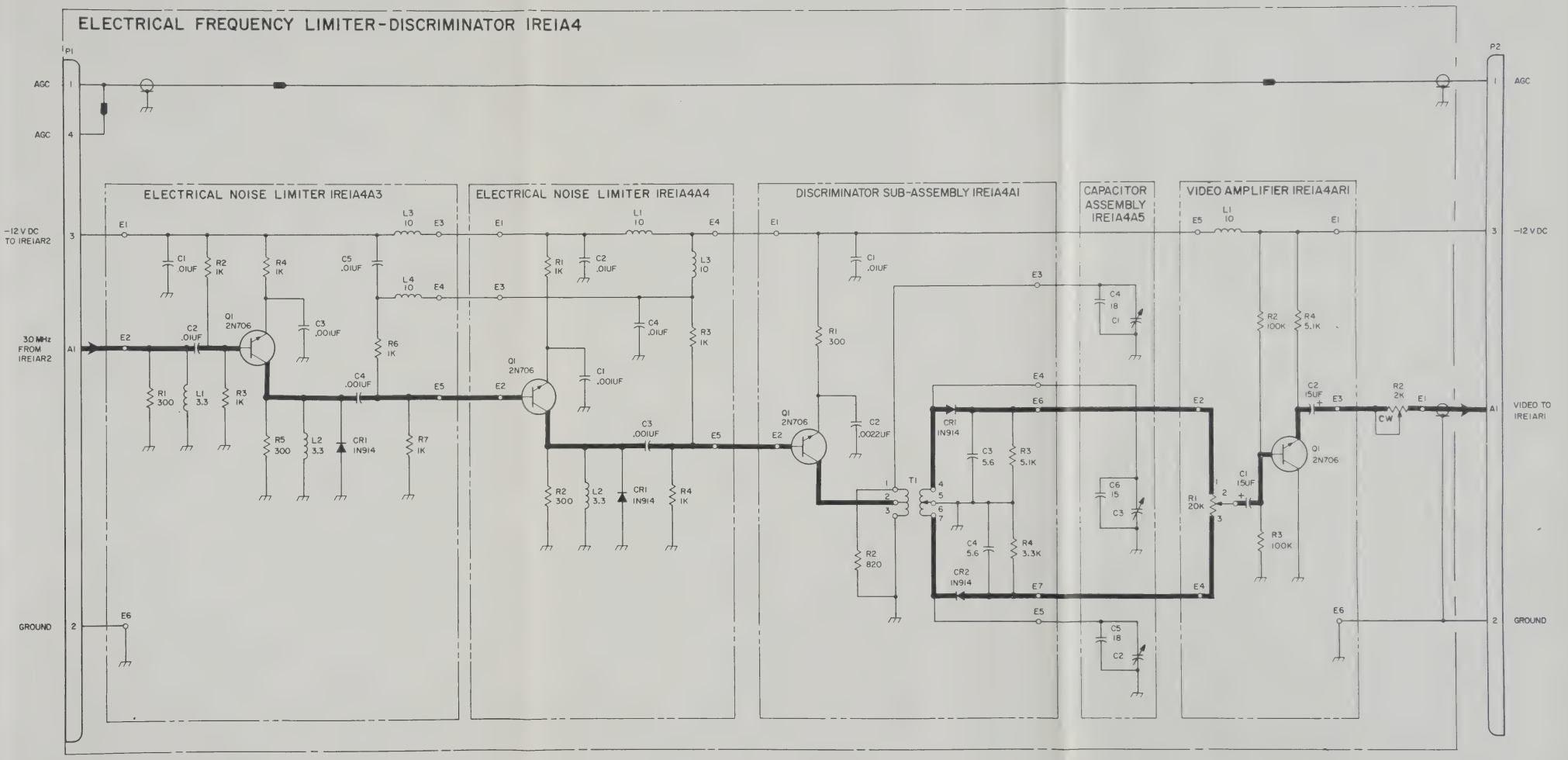
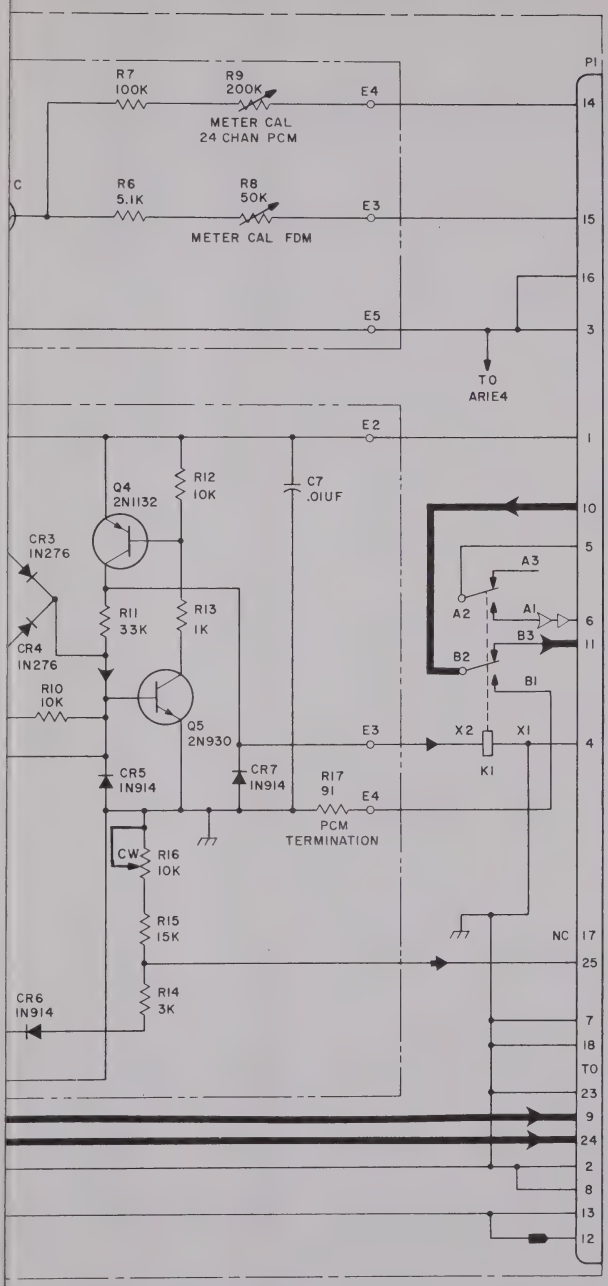


Figure 6-23. Electrical frequency discriminator 1RE1A4, schematic diagram.


P1
R7 100K
R9 200K
E4
METER CAL 24 CHAN PCM
14
METER 24CHAN PCM
C
R6 5.1K
R8 50K
E3
METER CAL FDM
15
METER FDM.
16
METER COM VIDEO
E5
3
-12V DC
TO ARIE4
E2
1
+12V DC
Q4 2N1132
R12 10K
C7 .01UF
10
PCM REGEN FROM IREIA3
CR3 IN276
5
26V (N)
A3
A2
A1
6
LOW SIG ALARM
CR4 IN276
R11 33K
R13 1K
B3
11
PCM OUT TO PCM CONNECTOR
B2
B1
R10 10K
Q5 2N930
E3
X2
X1
4
GROUND
K1
CR5 IN914
CR7 IN914
R17 91
E4
PCM TERMINATION
CW
R16 10K
R15 15K
NC
17
25
METER RCVR SIG
R14 3K
CR6 IN914
7
18
TO
23
GROUND
9
VIDEO PCM TO IREIA3
24
VIDEO OUT TO IA2AI
2
DC COMMON
8
GROUND
13
METER COMMON RCVR SIG
12
AGC TO 2AIA2ARI

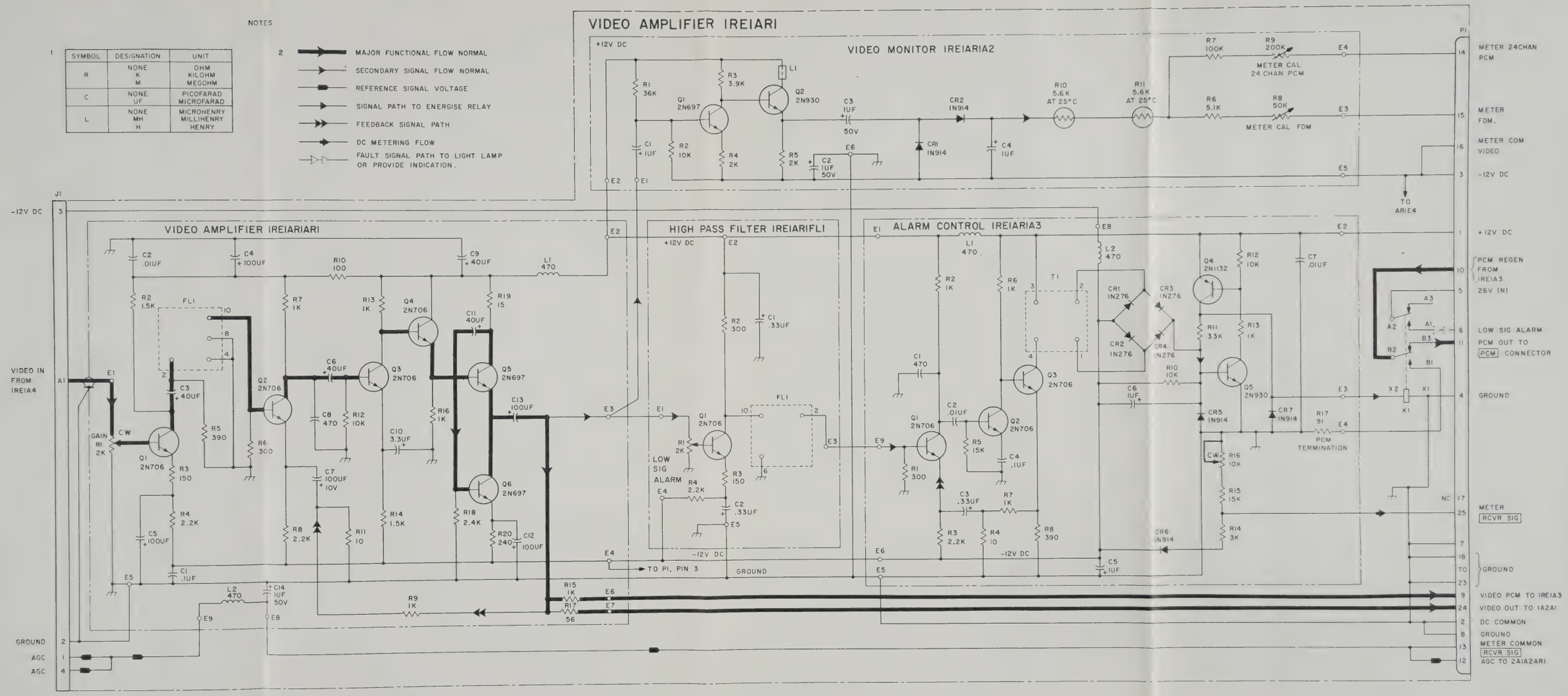
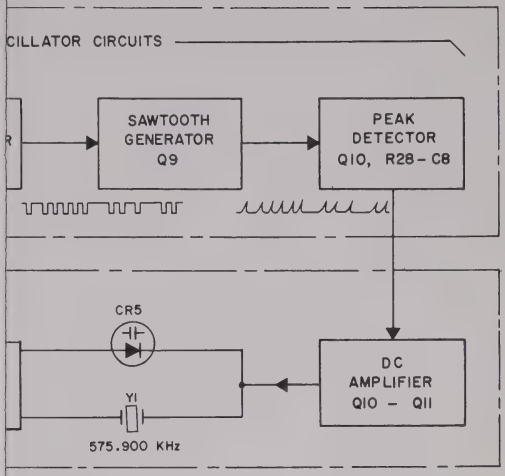


Figure 6-24. Video amplifier 1RE1AR1, schematic diagram.



TMG OUT
TIMING PULSES OUT

PCM METER OUT

PCM OUT 12 CHANNEL
2V P-P 91 OHMS
TERMINATION

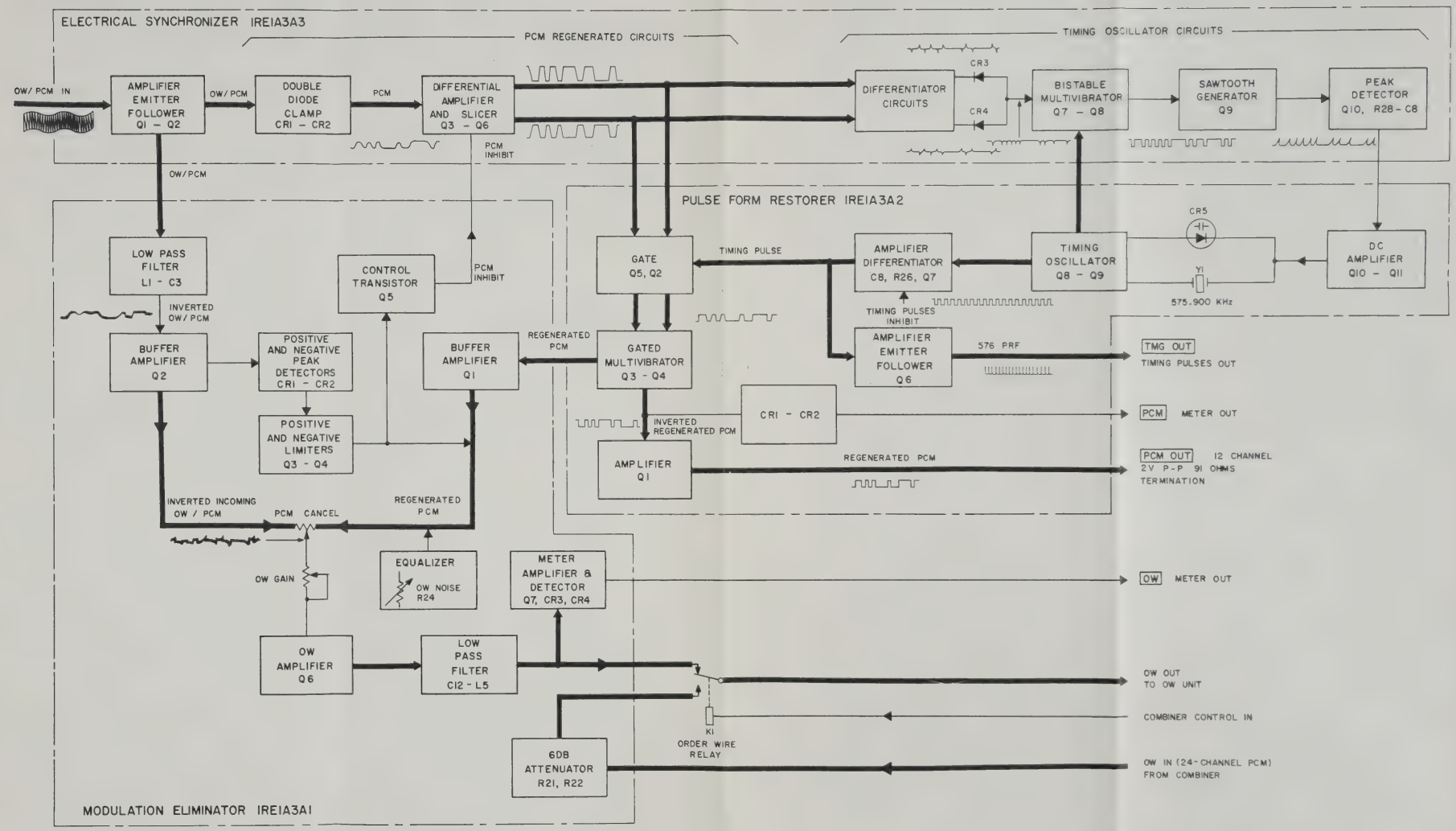
OW METER OUT

OW OUT
TO OW UNIT

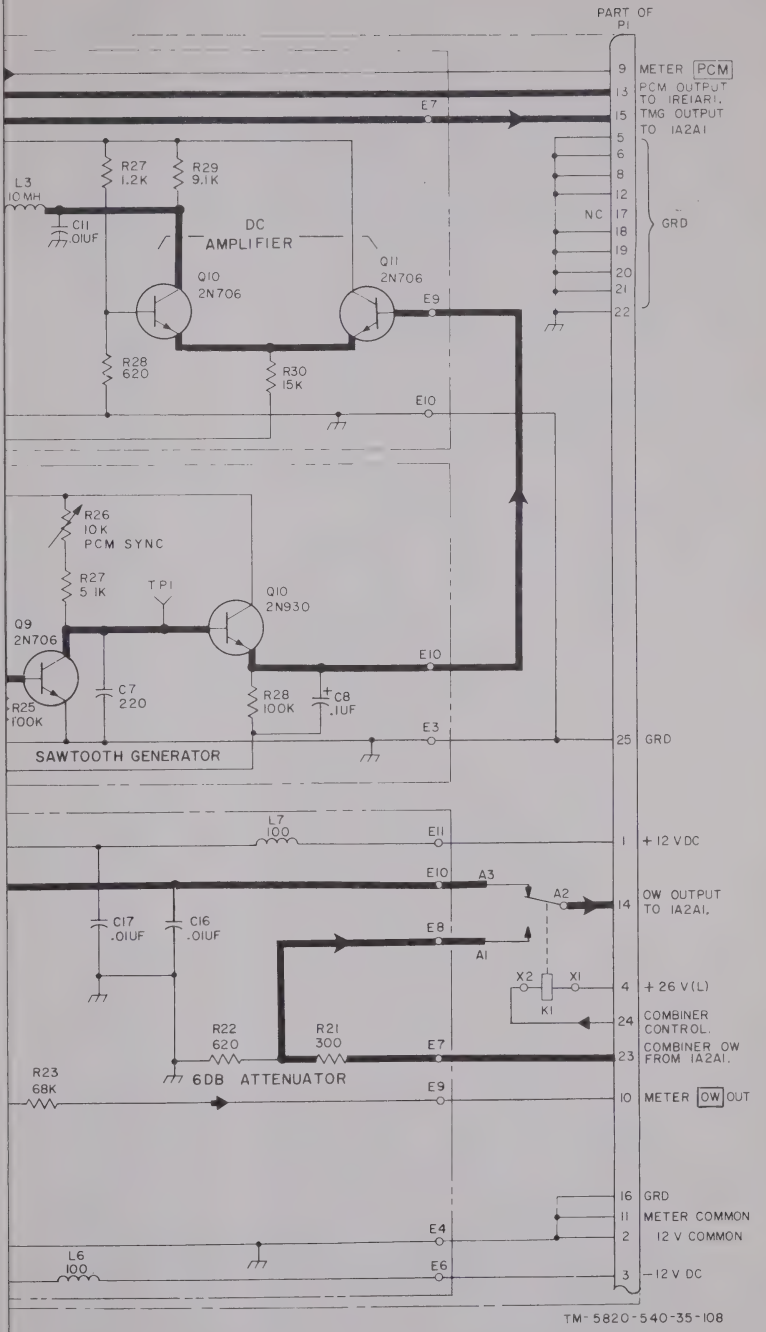
COMBINER CONTROL IN

OW IN (24-CHANNEL PCM)
FROM COMBINER

TM5820-540-35-107



TM5820-540-35-107

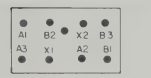

PART OF P1
9 METER PCM
13 PCM OUTPUT TO 1RE1AR1.
15 TMG OUTPUT TO 1A2A1
5
6
8
12
NC 17
18
19
20
21
22 GRD
E7
L3 10 MH
C11 .01UF
R27 1.2K
R29 9.1K
DC AMPLIFIER
Q10 2N706
Q11 2N706
E9
R28 620
R30 15K
E10
R26 10K PCM SYNC
R27 5.1K
TP1
Q10 2N930
Q9 2N706
R25 100K
C7 220
R28 100K
C8 .1UF
E10
E3
25 GRD
SAWTOOTH GENERATOR
L7 100
E11
1 + 12 VDC
E10
A3
A2
14 OW OUTPUT TO 1A2A1.
C17 .01UF
C16 .01UF
E8
A1
X2
X1
4 + 26 V(L)
K1
24 COMBINER CONTROL.
R22 620
R21 300
E7
23 COMBINER OW FROM 1A2A1.
R23 68K
6DB ATTENUATOR
E9
10 METER OW OUT
16 GRD
11 METER COMMON
E4
2 12 V COMMON
L6 100
E6
3 -12 V DC
TM-5820-540-35-108

NOTES

1

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2 RELAY BASE PINS AS VIEWED FROM END



3
- MAJOR FUNCTIONAL FLOW
- SECONDARY SIGNAL FLOW
- SIGNAL PATH TO ENERGIZE RELAY
- DC METERING FLOW
- FEEDBACK SIGNAL PATH

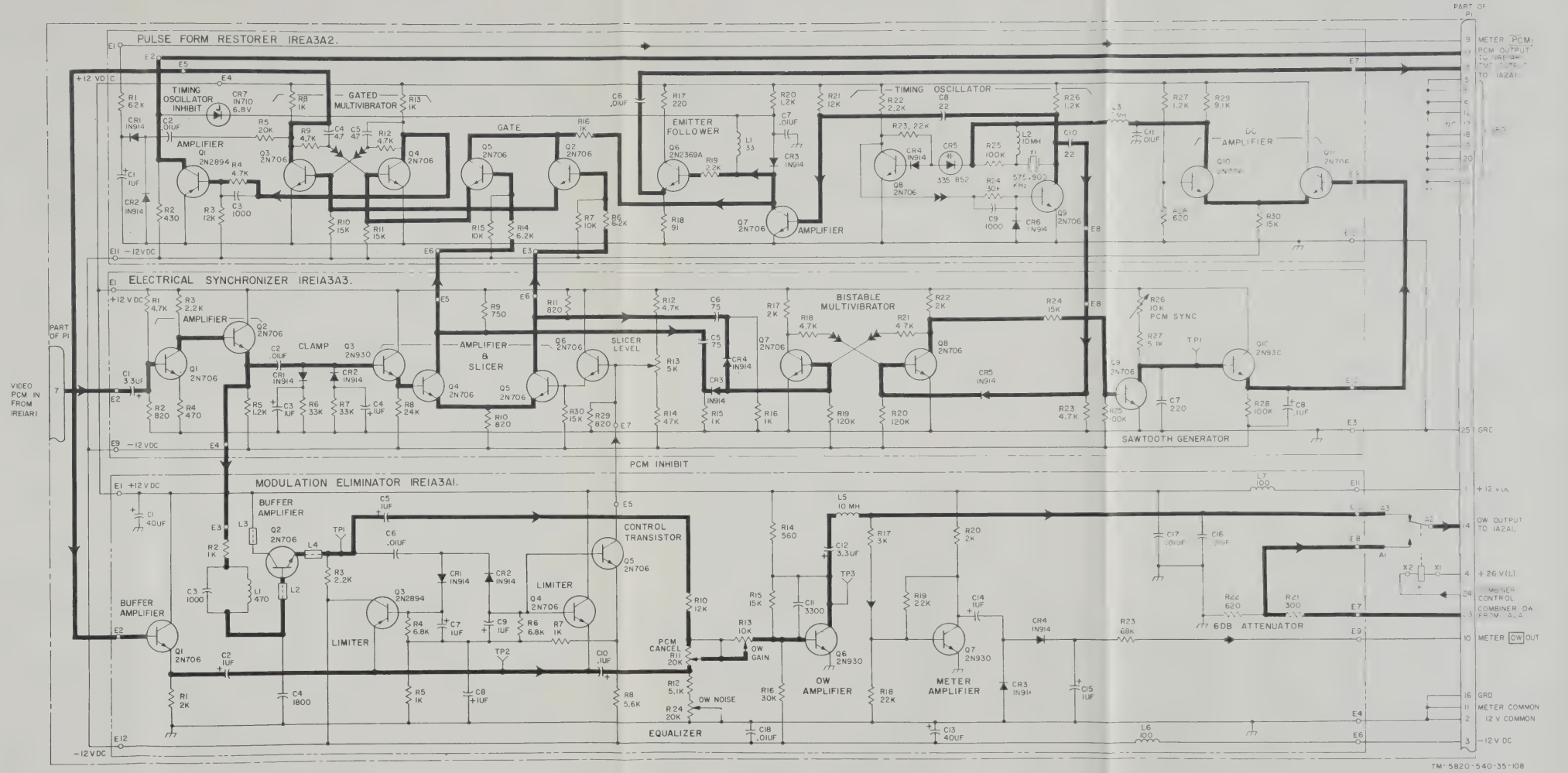
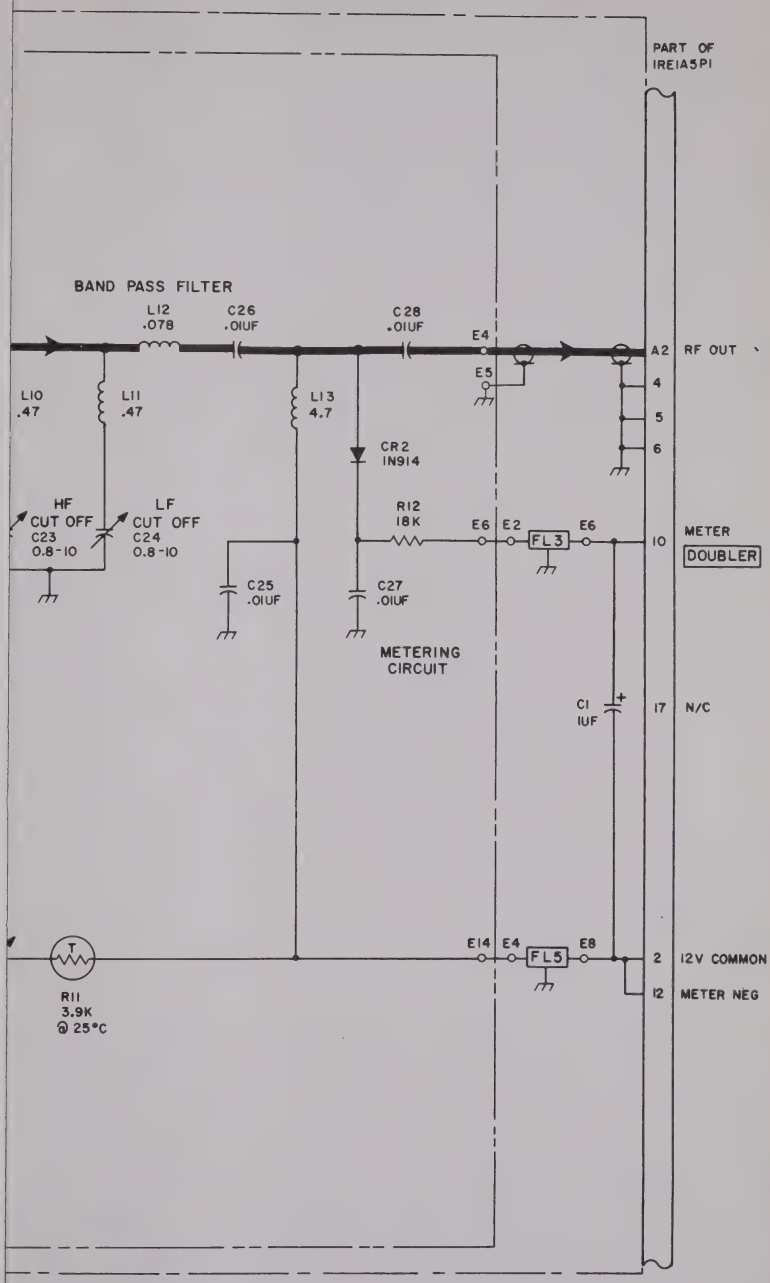


Figure 6-26. Pulse form restorer 1REIA3, schematic diagram.



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NOTES

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. DC METERING FLOW
MAJOR FUNCTIONAL FLOW
REFERENCE SIGNAL VOLTAGE

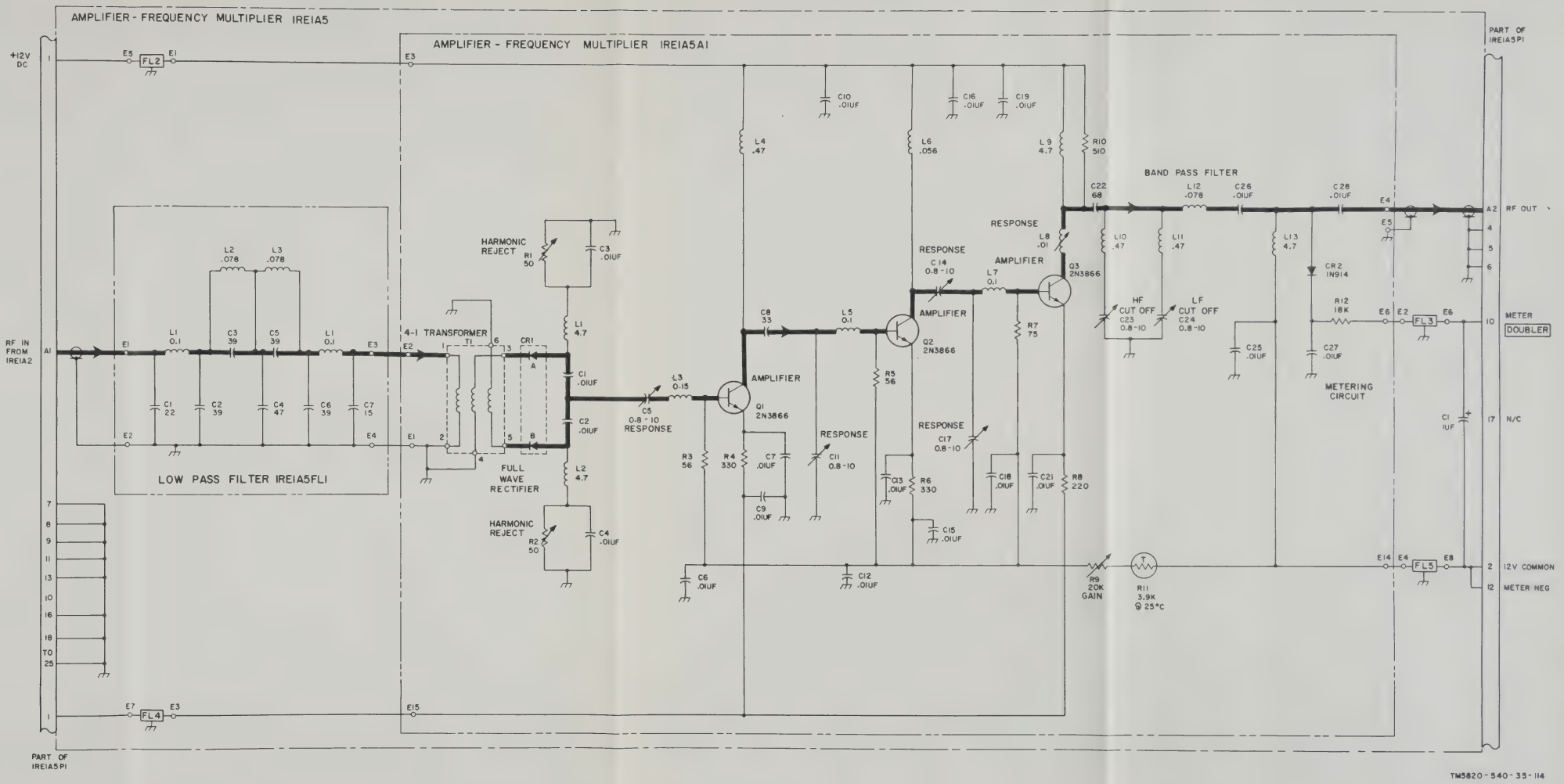
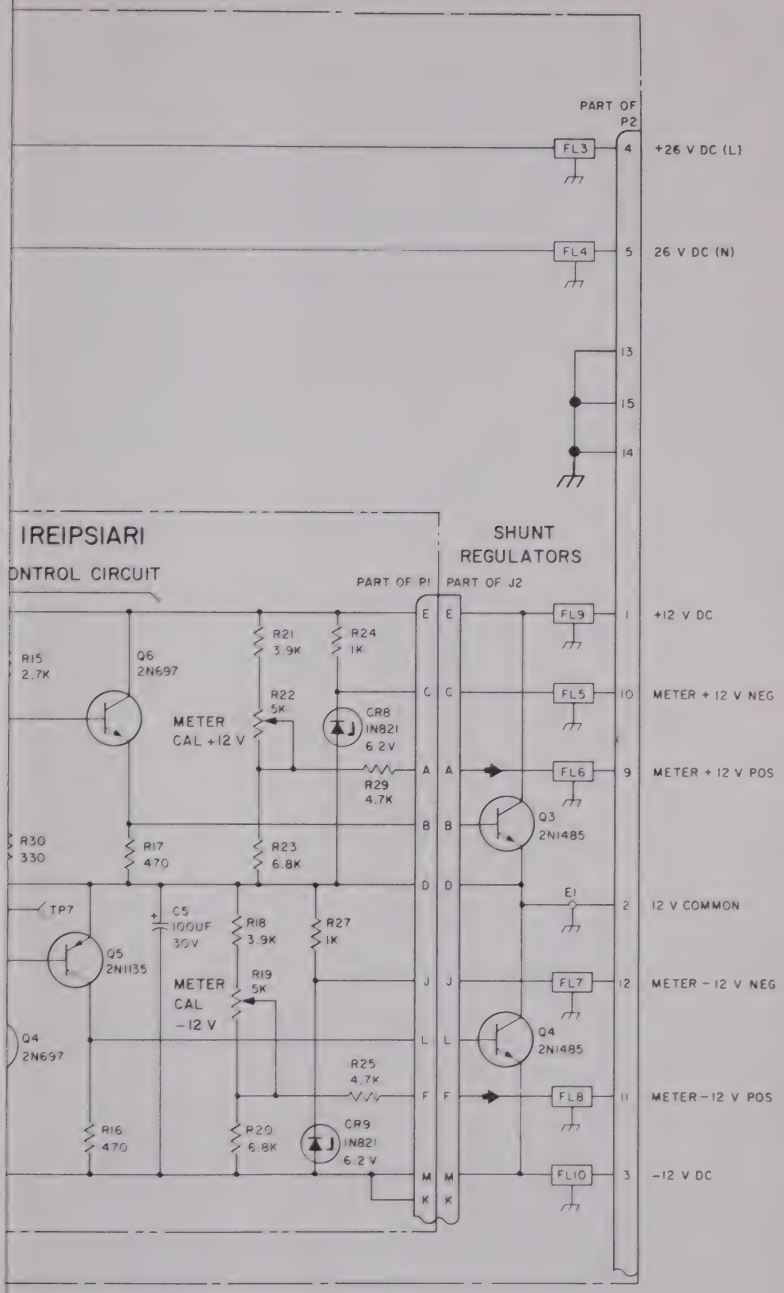


Figure 6-27. Amplifier-frequency multiplier 1RE1A5, schematic diagram.



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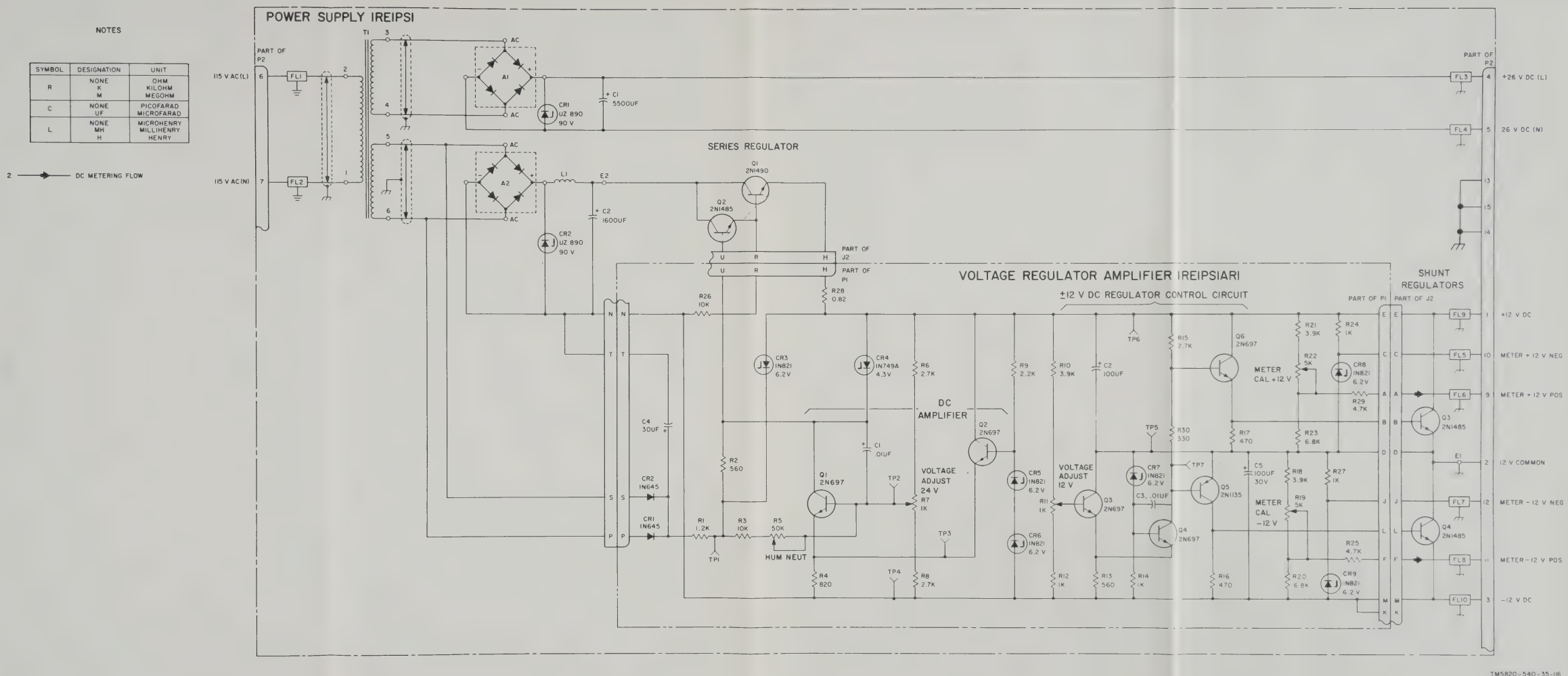
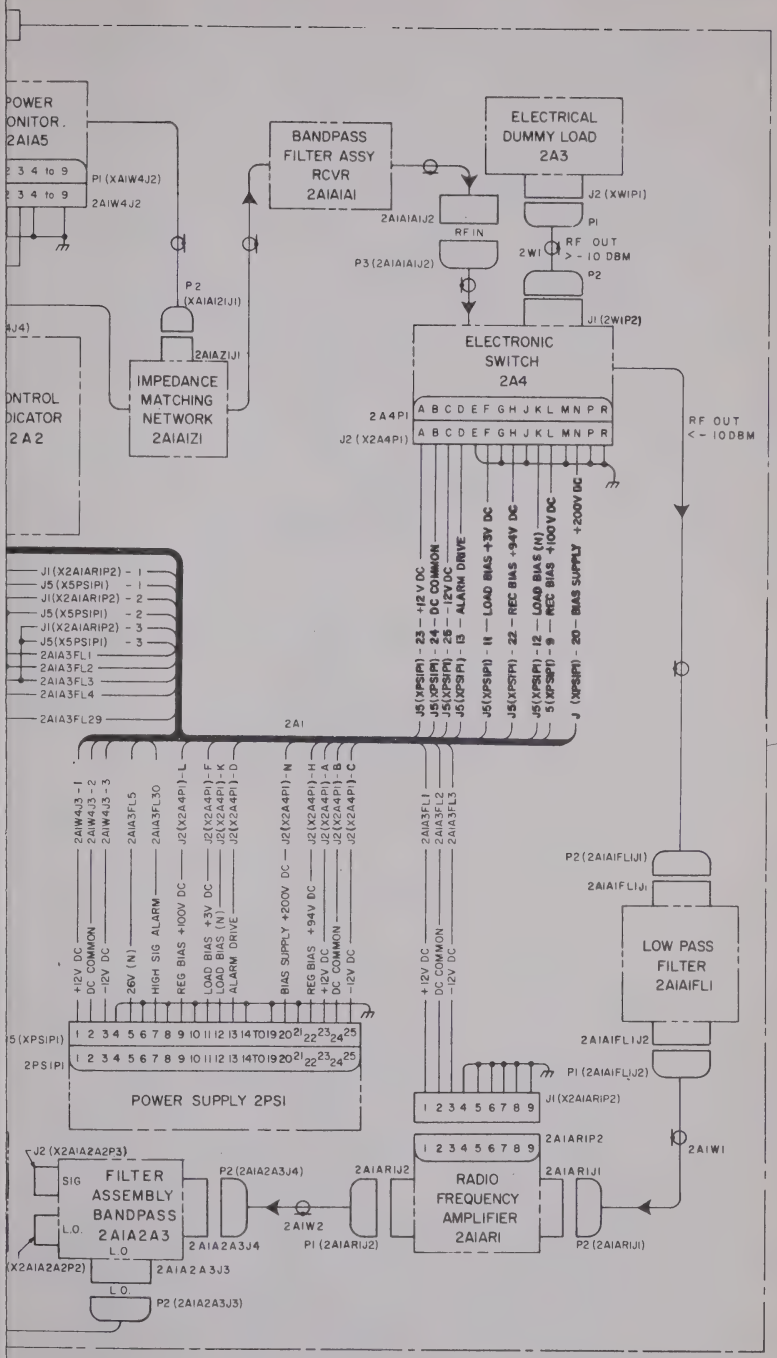


Figure 6-28. Power supply 1RE1PS1, schematic diagram.


POWER
ONITOR.
2AIA5
2 3 4 to 9
PI (XAIW4J2)
2 3 4 to 9
2AIW4J2
BANDPASS
FILTER ASSY
RCVR
2AIAIAI
ELECTRICAL
DUMMY LOAD
2A3
J2 (XWIPI)
2AIAIAIJ2
RF IN
PI
2WI
RF OUT
> - 10 DBM
P3 (2AIAIAIJ2)
P2
P2
(XAIAI2IJI)
J1 (2WIP2)
4J4)
ELECTRONIC
SWITCH
2A4
2AIAZIJI
IMPEDANCE
MATCHING
NETWORK
2AIAIZI
ONTROL
DICATOR
2A2
2A4PI
A B C D E F G H J K L MN P R
J2 (X2A4PI)
A B C D E F G H J K L MN P R
RF OUT
<- 10DBM
J1 (X2AIARIP2) - 1
J5 (X5PSIPI) - 1
J1 (X2AIARIP2) - 2
J5 (X5PSIPI) - 2
J1 (X2AIARIP2) - 3
J5 (X5PSIPI) - 3
2AIA3FL1
2AIA3FL2
2AIA3FL3
2AIA3FL4
2AIA3FL29
J5 (XPSIPI) - 23 — +12 V DC
J5 (XPSIPI) - 24 — DC COMMON
J5 (XPSIPI) - 25 — -12V DC
J5 (XPSIPI) - 13 — ALARM DRIVE
J5 (XPSIPI) - 11 — LOAD BIAS +3V DC
J5 (XPSIPI) - 22 — REC BIAS +94V DC
J5 (XPSIPI) - 12 — LOAD BIAS (N)
J5 (XPSIPI) - 9 — REC BIAS +100V DC
J (XPSIPI) - 20 — BIAS SUPPLY +200V DC
2AI
2AIW4J3 - 1
2AIW4J3 - 2
2AIW4J3 - 3
2AIA3FL5
2AIA3FL30
J2 (X2A4PI) - L
J2 (X2A4PI) - F
J2 (X2A4PI) - K
J2 (X2A4PI) - D
J2 (X2A4PI) - N
J2 (X2A4PI) - H
J2 (X2A4PI) - A
J2 (X2A4PI) - B
J2 (X2A4PI) - C
+12V DC
DC COMMON
-12V DC
26V (N)
HIGH SIG ALARM
REG BIAS +100V DC
LOAD BIAS +3V DC
LOAD BIAS (N)
ALARM DRIVE
BIAS SUPPLY +200V DC
REG BIAS +94V DC
+12V DC
DC COMMON
-12V DC
2AIA3FL1
2AIA3FL2
2AIA3FL3
+12V DC
DC COMMON
-12V DC
P2 (2AIAIFLIJI)
2AIAIFLIJI
LOW PASS
FILTER
2AIAIFLI
2AIAIFLIJ2
5 (XPSIPI)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 TO 19 20 21 22 23 24 25
2PSIPI
1 2 3 4 5 6 7 8 9 10 11 12 13 14 TO 19 20 21 22 23 24 25
POWER SUPPLY 2PSI
PI (2AIAIFLIJ2)
1 2 3 4 5 6 7 8 9
J1 (X2AIARIP2)
J2 (X2AIA2A2P3)
SIG
L.O.
FILTER
ASSEMBLY
BANDPASS
2AIA2A3
L.O
2AIA2A3J4
P2 (2AIA2A3J4)
2AIW2
2AIARIJ2
PI (2AIARIJ2)
1 2 3 4 5 6 7 8 9
2AIARIP2
2AIWI
2AIARIJI
RADIO
FREQUENCY
AMPLIFIER
2AIARI
P2 (2AIARIJI)
(X2AIA2A2P2)
2AIA2A3J3
L.O.
P2 (2AIA2A3J3)

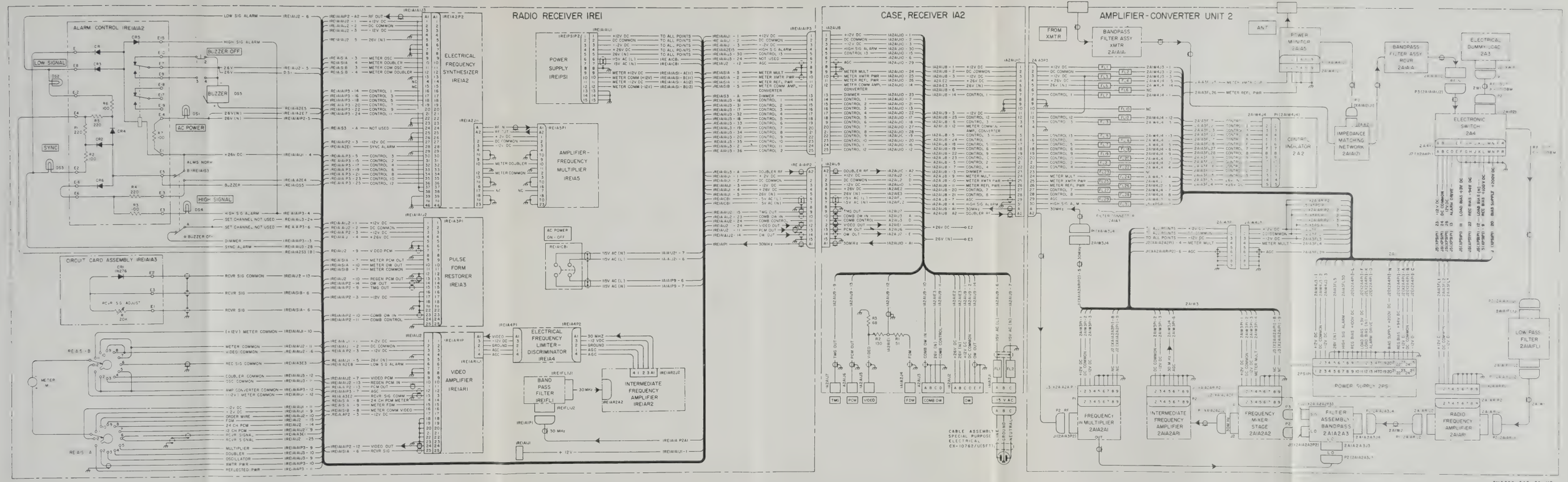
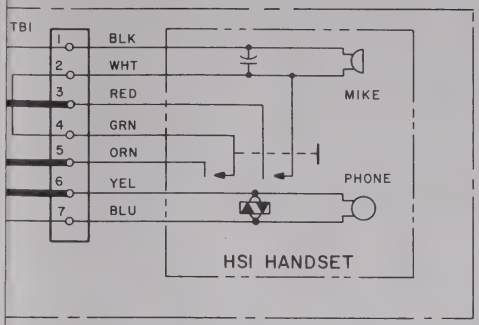


Figure 6-29. Receiver, Radio R-1329(P)/GRC-103(V), interconnection diagram.



NOTES

2.

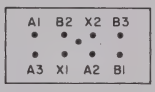
DESIGNATION	UNIT
NONE K M	OHM KILOHM MEGOHM
NONE UF	PICOFARAD MICROFARAD
NONE MH H	MICROHENRY MILLIHENRY HENRY

MAJOR FUNCTIONAL FLOW

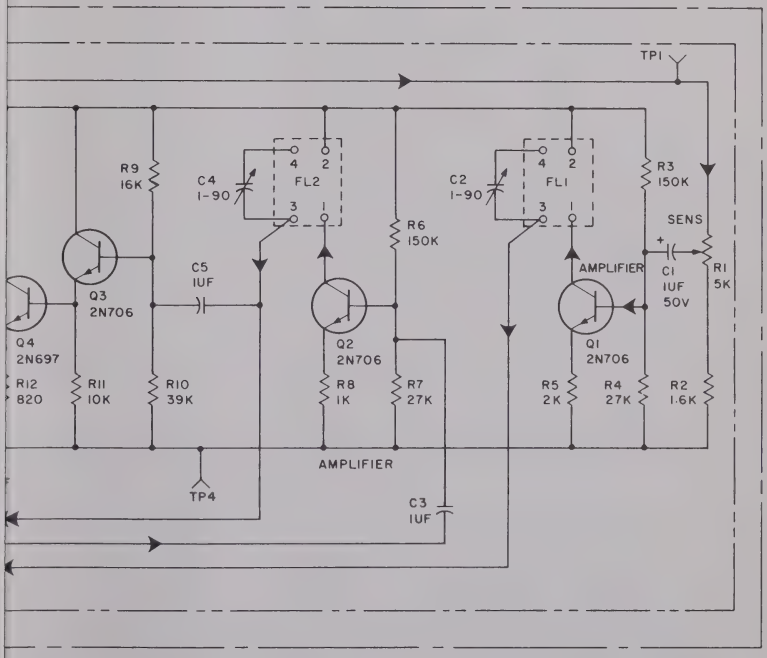
SECONDARY FUNCTIONAL FLOW

FAULT SIGNAL PATH TO LIGHT LAMP OR PROVIDE INDICATION

FEEDBACK SIGNAL PATH



RELAY BASE PINS AS VIEWED FROM THE PIN END



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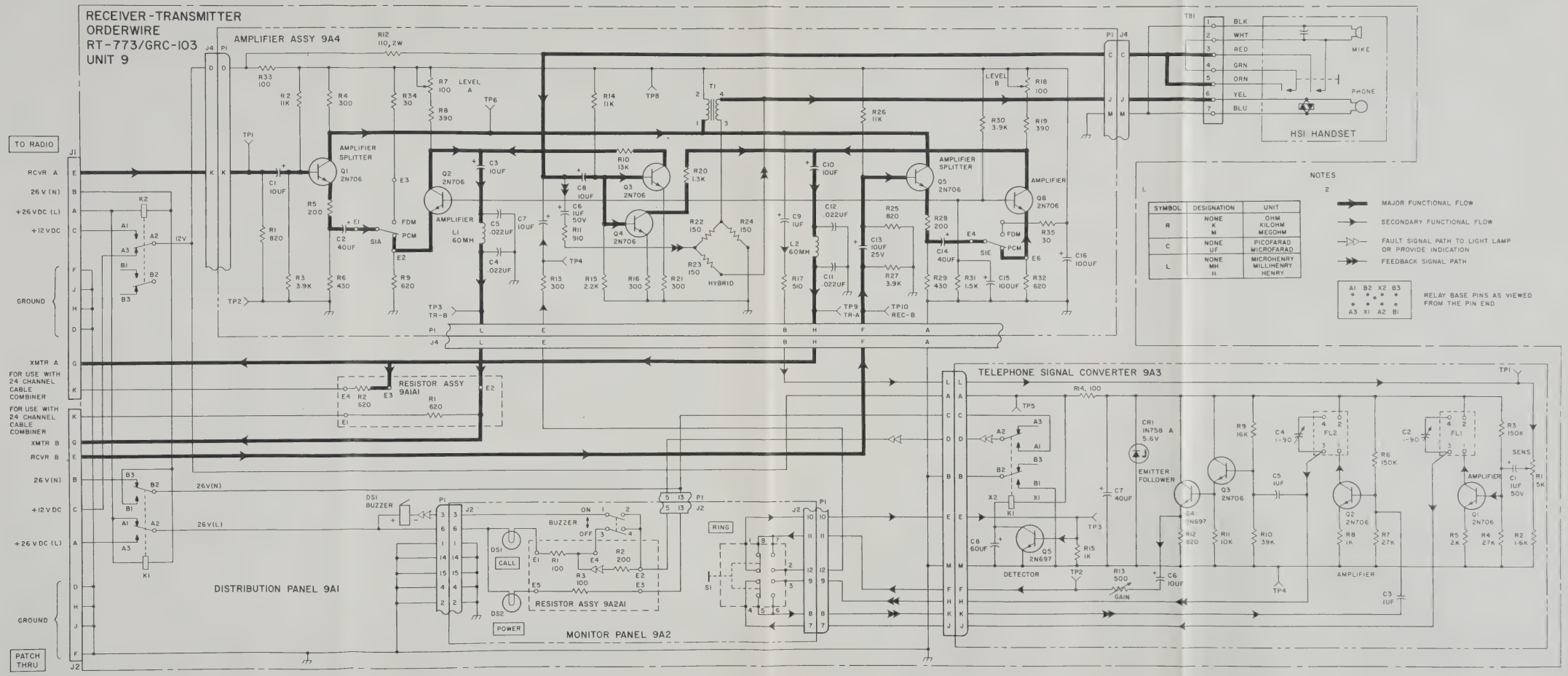
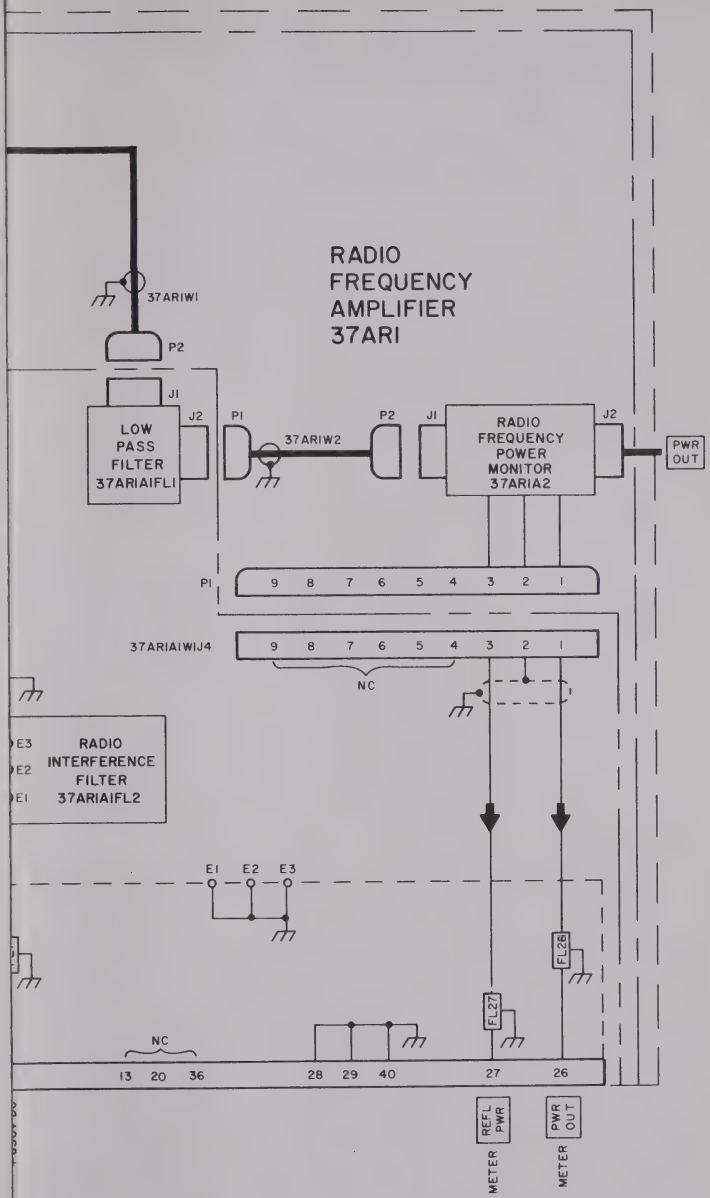


Figure 6-30. Receiver-Transmitter Order Wire TR-773/GRC-103(V), schematic diagram.



plifier-Frequency Multiplier AM-4321/GRC-103(V), band II transmitter RF head, schematic diagram.

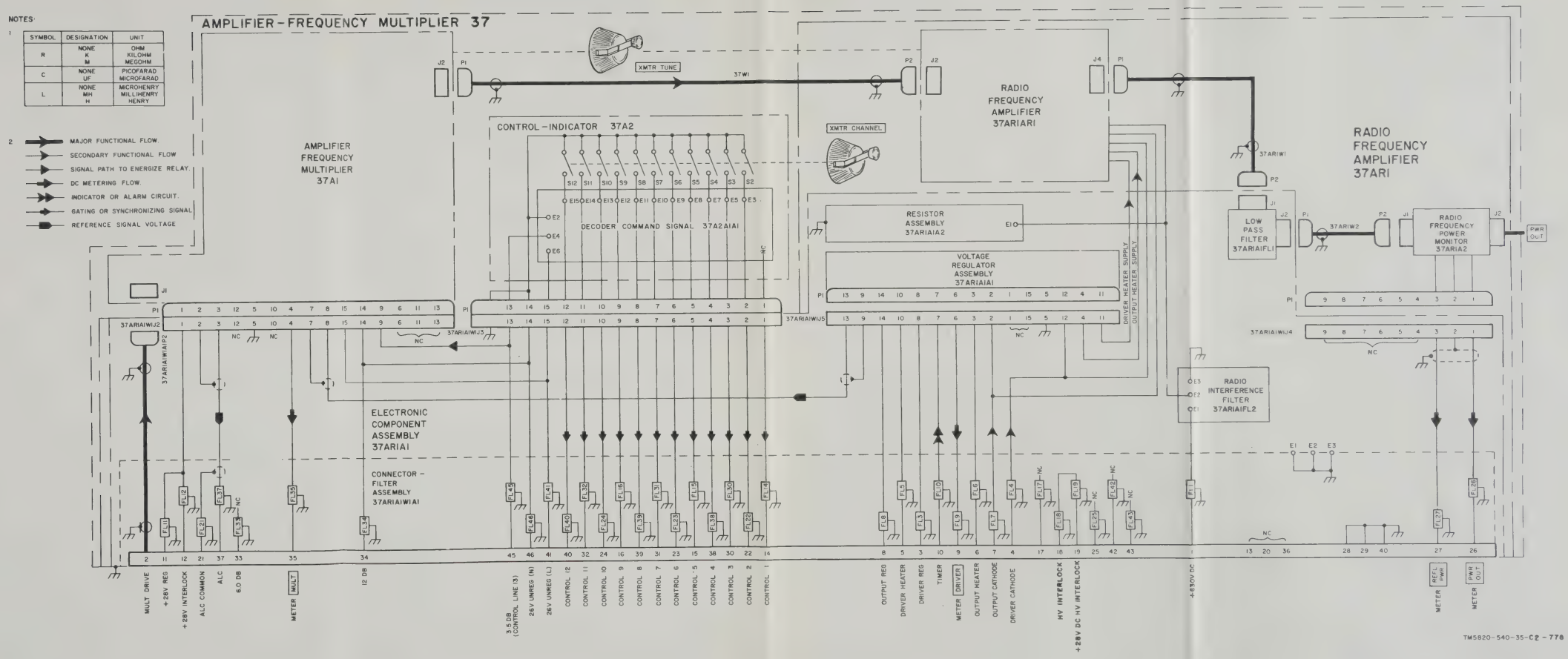
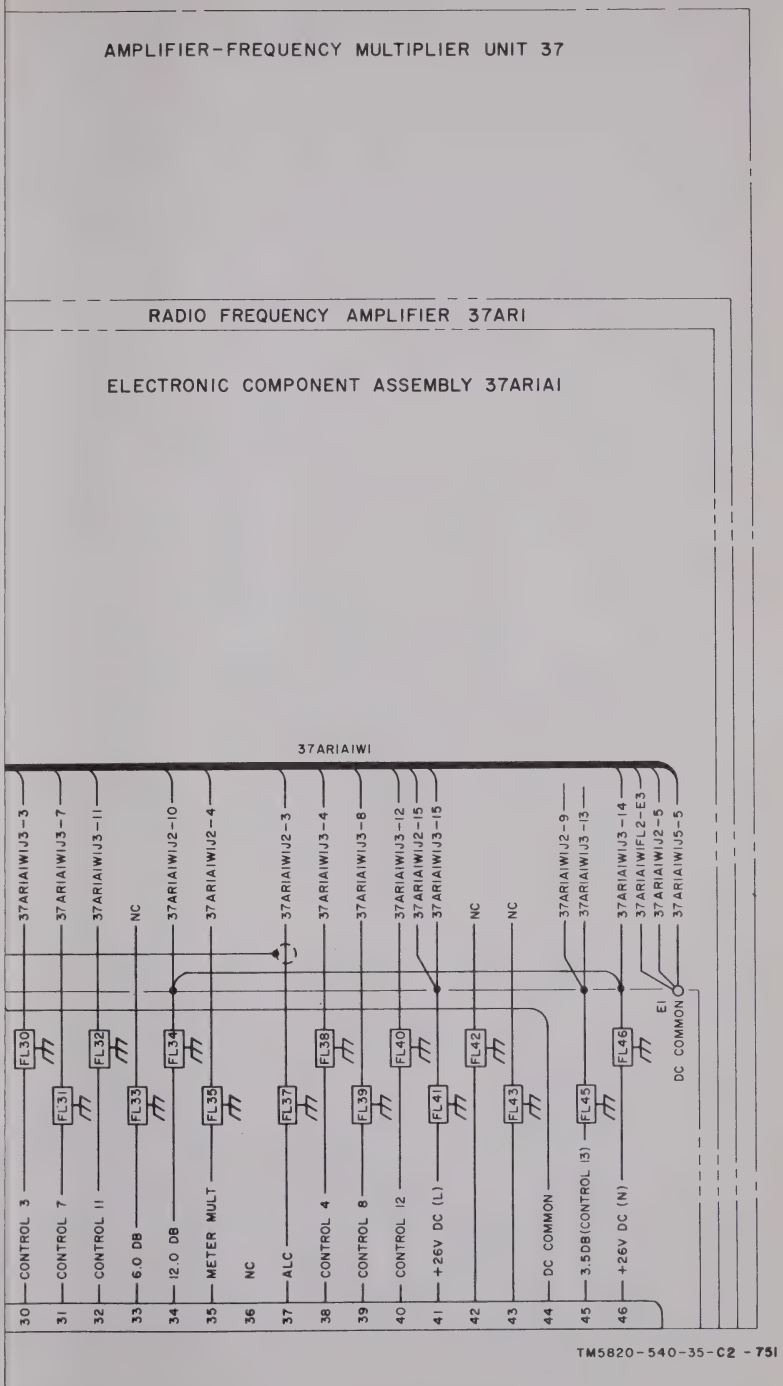


Figure 7-1. Amplifier-Frequency Multiplier AM-4321/GRC-103(V), band II transmitter RF head, schematic diagram.



2. Amplifier-Frequency Multiplier AM-4321/GRC-103(V), band II transmitter RF head, interconnecting diagram.

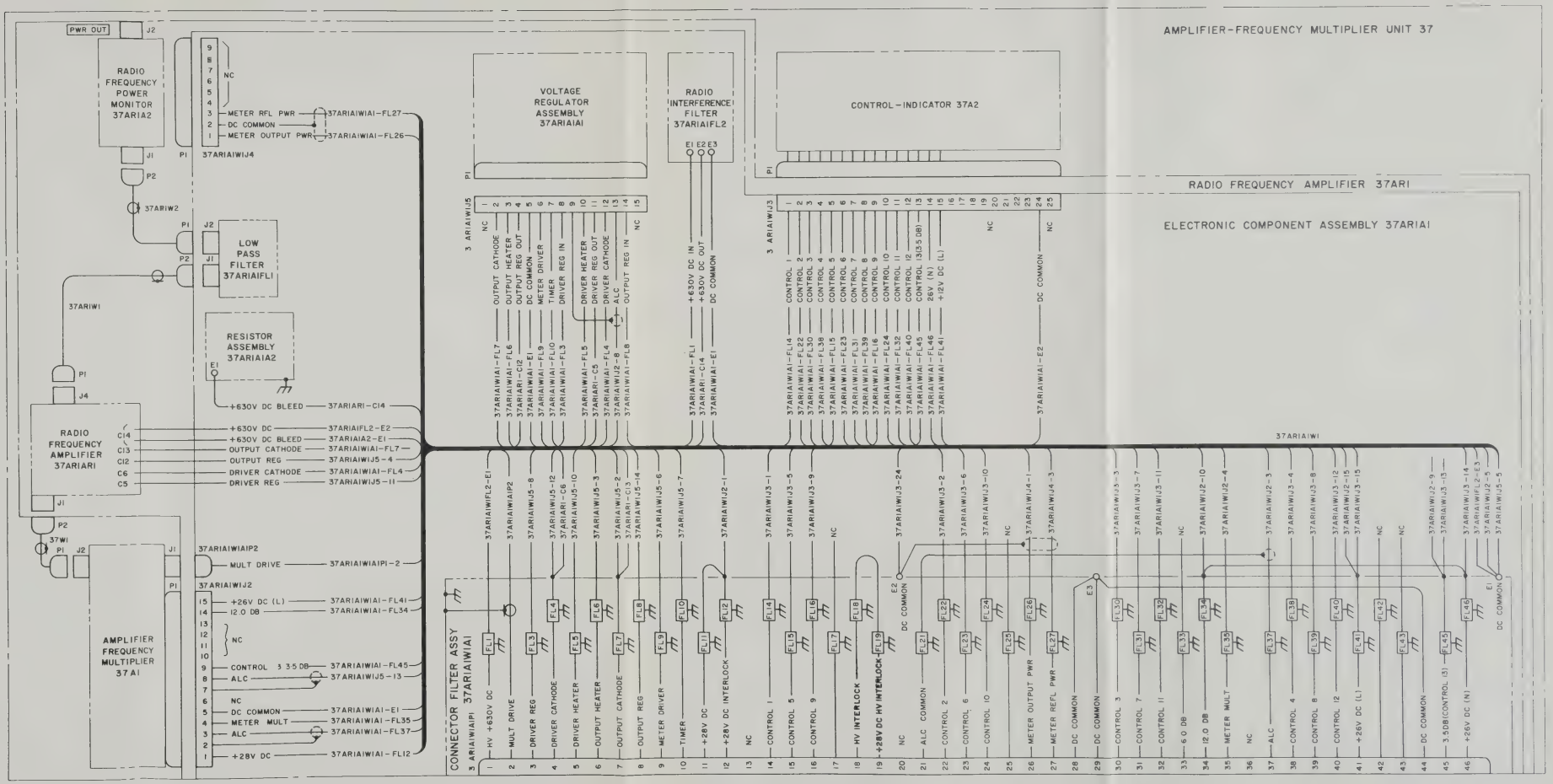
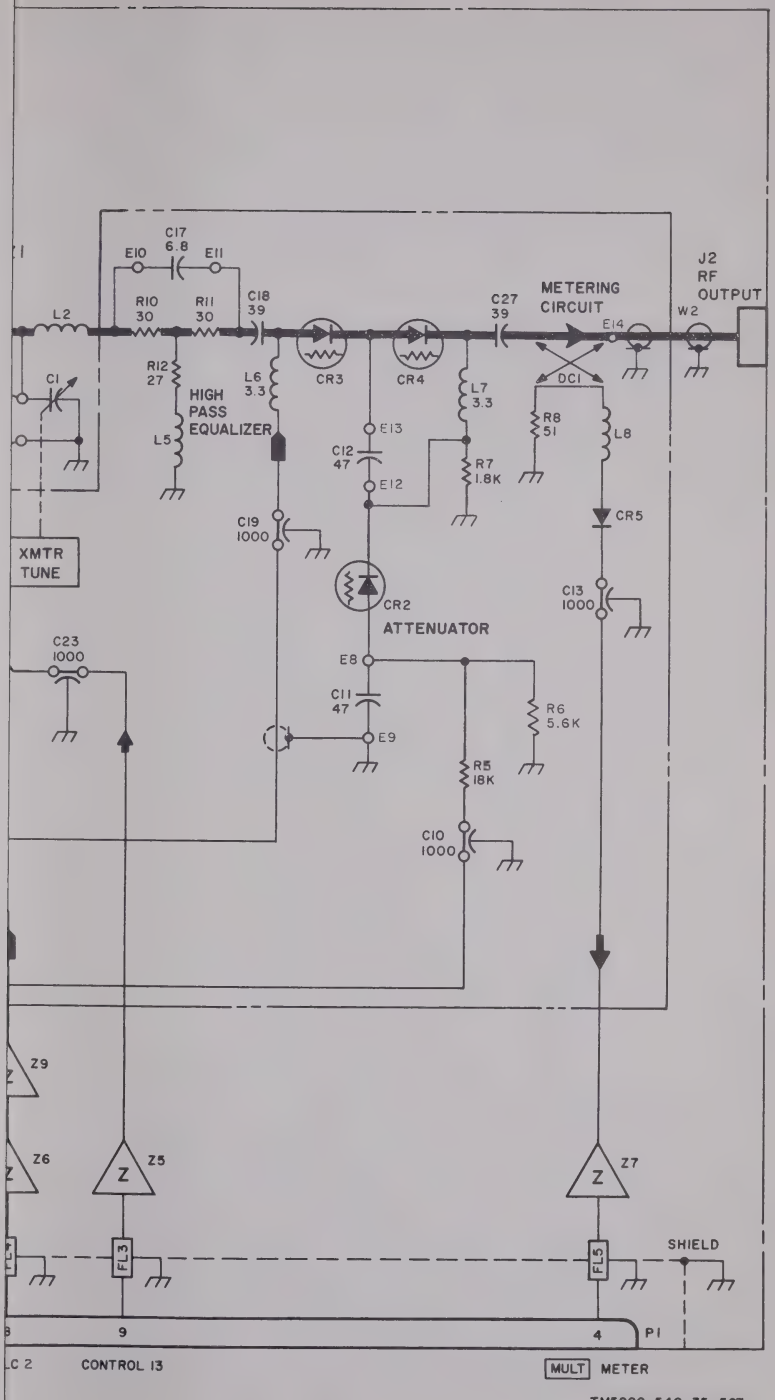


Figure 7-2. Amplifier-Frequency Multiplier AM-4321/GRC-103(V), band II transmitter RF head, interconnecting diagram.



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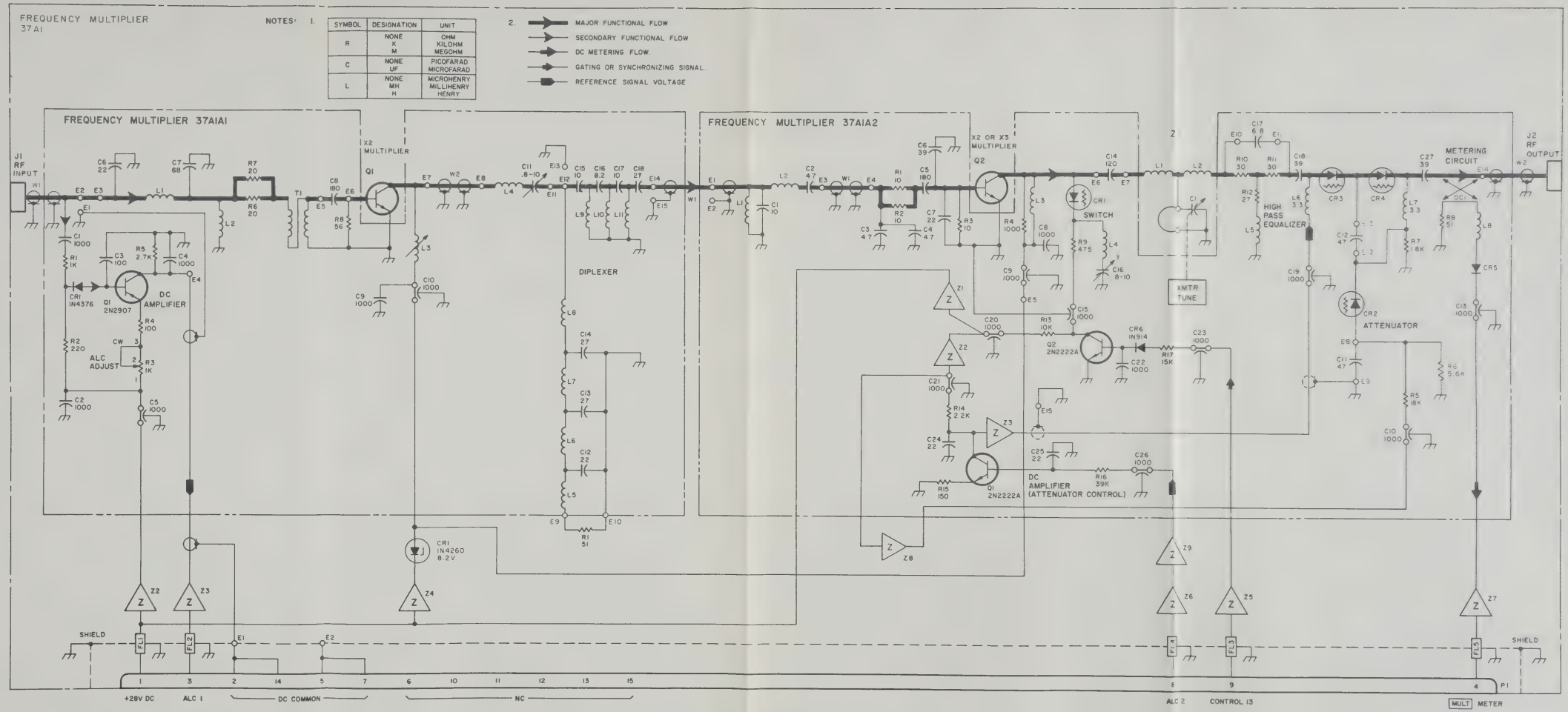

Figure 7-3. Frequency multiplier 37A1, schematic diagram.

NG					
8	9	10	11	12	13
	●			●	
●	●			●	
●	●			●	
●	●			●	
●	●			●	
●	●			●	
●	●			●	
●	●			●	
●	●			●	
●	●			●	
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●	●			●	
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●	●			●	
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		●		●	
		●		●	
		●		●	
		●		●	
		●		●	

CHANNEL NO		CODING												
XMTR	RCVR	1	2	3	4	5	6	7	8	9	10	11	12	13
934	874			●	●		●	●			●		●	
935	875		●	●	●		●	●			●		●	
936	876					●	●	●			●		●	
937	877		●			●	●	●			●		●	
938	878			●		●	●	●			●		●	
939	879		●	●		●	●	●			●		●	
940	880				●	●	●	●			●		●	
941	881		●		●	●	●	●			●		●	
942	882			●	●	●	●	●			●		●	
943	883		●	●	●	●	●	●			●		●	
944	884								●		●		●	
945	885		●						●		●		●	
946	886			●					●		●		●	
947	887		●	●					●		●		●	
948	888				●				●		●		●	
949	889		●		●				●		●		●	
950	890			●	●				●		●		●	
951	891		●	●	●				●		●		●	
952	892					●			●		●		●	
953	893		●			●			●		●		●	
954	894			●		●			●		●		●	
955	895		●	●		●			●		●		●	
956	896				●	●			●		●		●	
957	897		●		●	●			●		●		●	
958	898			●	●	●			●		●		●	
959	899		●	●	●	●			●		●		●	
960	900						●		●		●		●	
961	901		●				●		●		●		●	
962	902			●			●		●		●		●	
963	903		●	●			●		●		●		●	
964	904				●		●		●		●		●	
965	905		●		●		●		●		●		●	
966	906			●	●		●		●		●		●	
967	907		●	●	●		●		●		●		●	
968	908					●	●		●		●		●	
969	909		●			●	●		●		●		●	
970	910			●		●	●		●		●		●	
971	911		●	●		●	●		●		●		●	
972	912				●	●	●		●		●		●	
973	913		●		●	●	●		●		●		●	
974	914			●	●	●	●		●		●		●	
975	915		●	●	●	●	●		●		●		●	
976	916							●	●		●		●	
977	917		●					●	●		●		●	
978	918			●				●	●		●		●	
979	919		●	●				●	●		●		●	
980	920				●			●	●		●		●	
981	921		●		●		●	●	●		●		●	
982	922			●	●			●	●		●		●	
983	923		●	●	●			●	●		●		●	
984	924					●		●	●		●		●	
985	925		●			●		●	●		●		●	
986	926			●		●		●	●		●		●	
987	927		●	●		●		●	●		●		●	
988	928				●	●		●	●		●		●	
989	929		●		●	●			●		●		●	
990	930			●	●	●		●	●		●		●	
991	931		●	●	●	●		●	●		●		●	
992	932						●	●	●		●		●	
993	933		●				●	●	●		●		●	
994	934			●			●	●	●		●		●	
995	935		●	●			●	●	●		●		●	
996	936				●		●	●	●		●		●	
997	937		●		●		●	●	●		●		●	
998	938			●	●		●	●	●		●		●	
999	939		●	●	●		●	●	●		●		●	
1000	940					●	●	●	●		●		●	
1001	941		●			●	●	●	●		●		●	

CHANNEL NO		CODING												
XMTR	RCVR	1	2	3	4	5	6	7	8	9	10	11	12	13
1002	942			●		●	●	●	●		●		●	
1003	943		●	●		●	●	●	●		●		●	
1004	944				●	●	●	●	●		●		●	
1005	945		●		●	●	●	●	●		●		●	
1006	946			●	●	●	●	●	●		●		●	
1007	947		●	●	●	●	●	●	●		●		●	
1008	948									●	●		●	
1009	949		●							●	●		●	
1010	950			●						●	●		●	
	951		●	●						●	●		●	
	952				●					●	●		●	
	953		●		●					●	●		●	
	954			●	●					●	●		●	
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	961		●		●	●				●	●		●	
	962			●	●	●				●	●		●	
	963		●	●	●	●				●	●		●	
	964						●			●	●		●	
	965		●				●			●	●		●	
	966			●			●			●	●		●	
	967		●	●			●			●	●		●	
	968				●		●			●	●		●	
	965		●		●		●			●	●		●	
	970			●	●		●			●	●		●	
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	973		●			●	●			●	●		●	
	974			●		●	●			●	●		●	
	975		●	●		●	●			●	●		●	
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	978			●	●	●	●			●	●		●	
	979		●	●	●	●	●			●	●		●	
	980							●		●	●		●	
	981		●					●		●	●		●	
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	983		●	●				●		●	●		●	
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	985		●		●			●		●	●		●	
	986			●	●			●		●	●		●	
	987		●	●	●			●		●	●		●	
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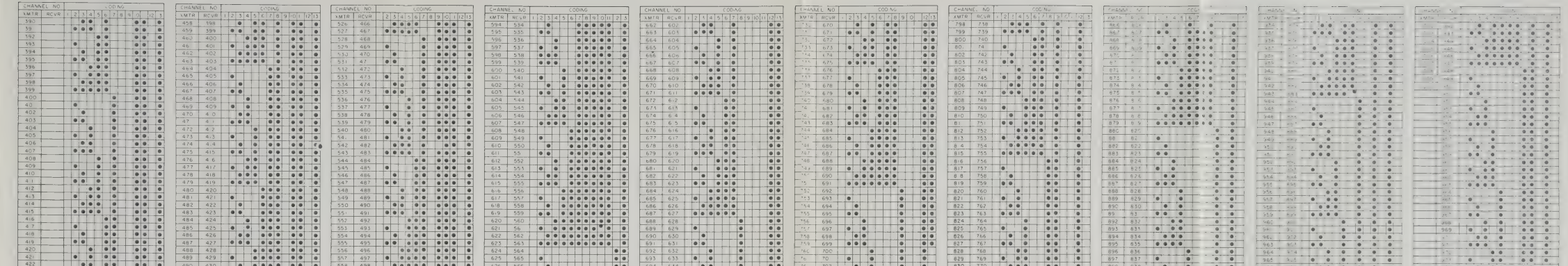
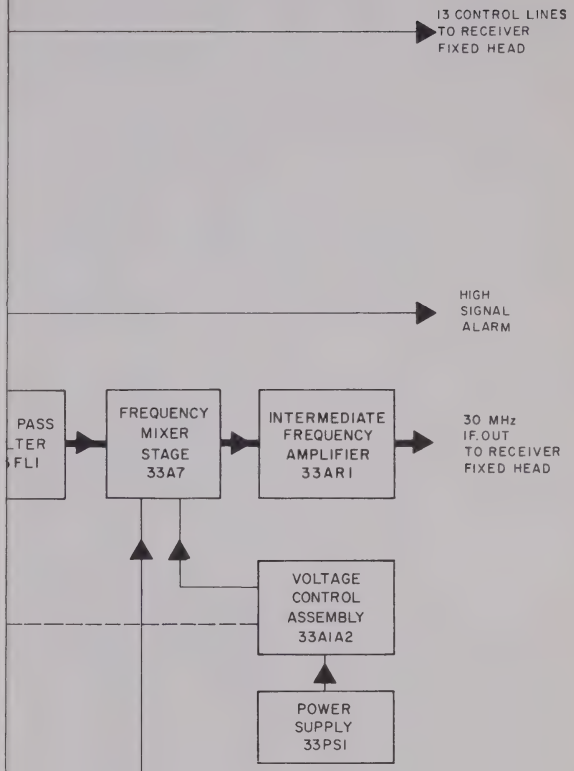
	1002			●	●		●	●		●	●		●	
	1003		●	●	●		●	●		●	●		●	
	1004					●	●	●		●	●		●	
	1005		●			●	●	●		●	●		●	
	1006			●		●	●	●		●	●		●	
	1007		●	●		●	●	●		●	●		●	
	1008				●	●	●	●		●	●		●	
	1009		●		●	●	●	●		●	●		●	
	1010			●	●	●	●	●		●	●		●	

TM5820-540-35-795



TM5820-540-35-795

Figure 7-4. Control-indicators 87A2 and 83A4, coding tables.



TM5820-540-35-748

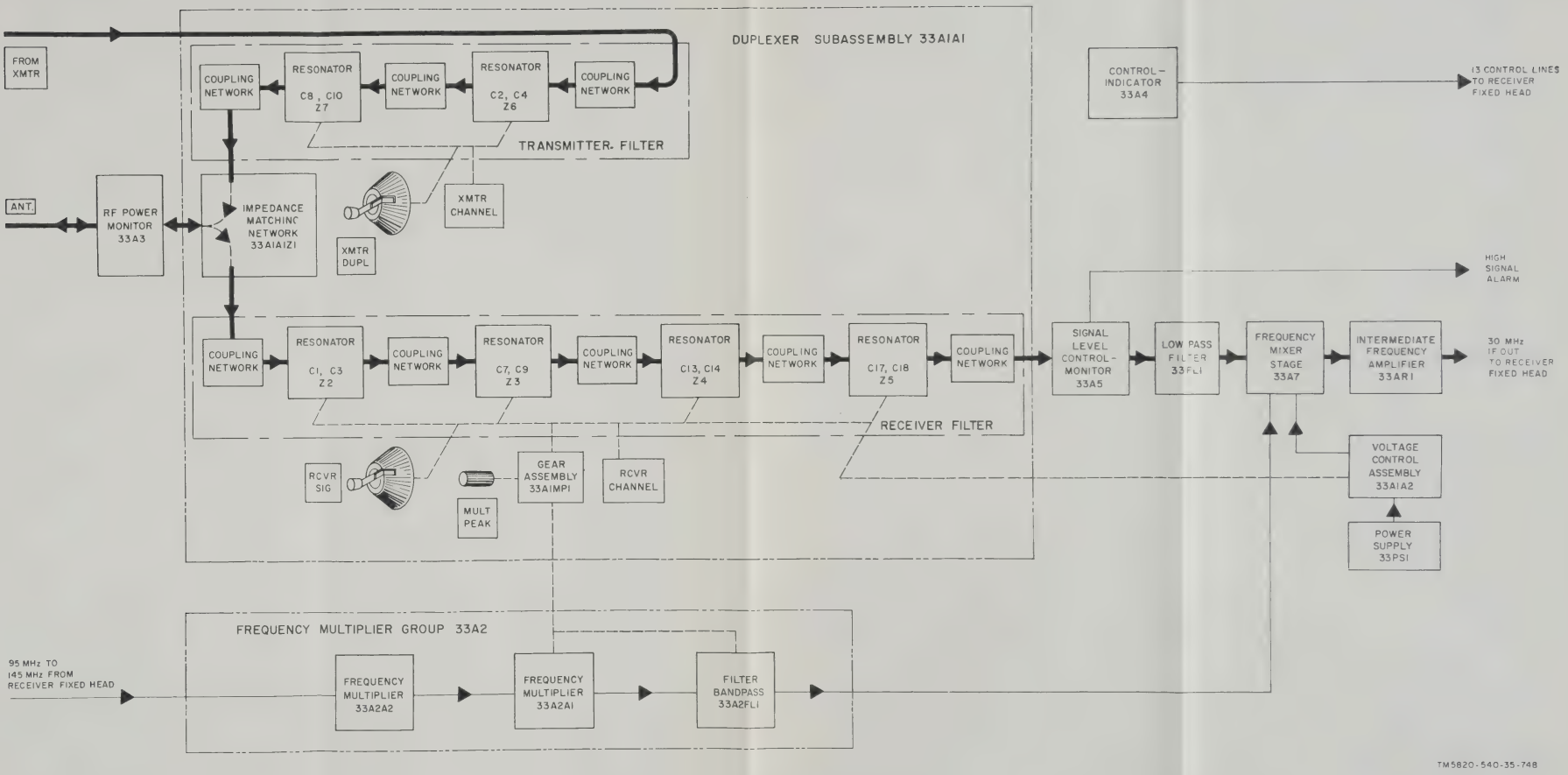


Figure 7-5. Amplifier-Converter AM-4317/GRC-103(V), band II receiver RF head, block diagram.

AMPLIFIER-CONVERTER, UNIT 33

NOTES:

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

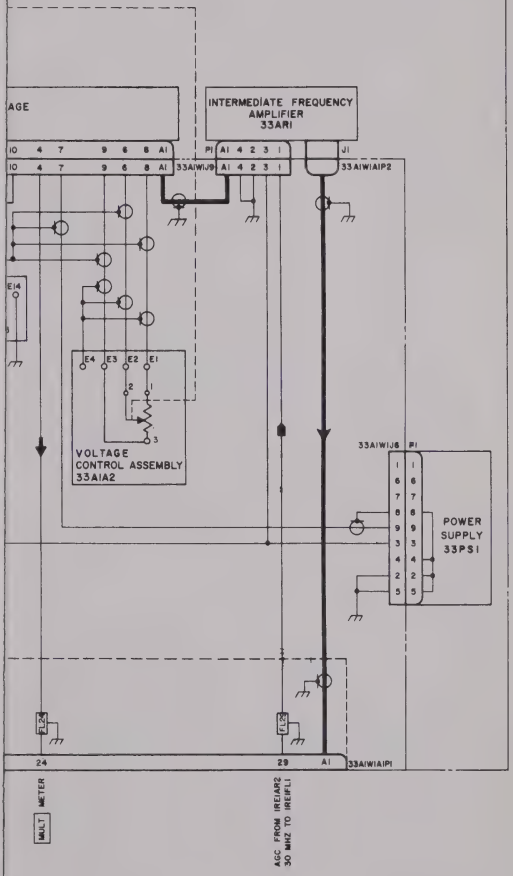
2 MAJOR FUNCTIONAL FLOW.

DC METERING FLOW.

FAULT SIGNAL PATH TO LAMP OR PROVIDE INDICATION.

GATING OR SYNCHRONIZING SIGNAL.

REFERENCE SIGNAL VOLTAGE.



TM5820-540-35-788

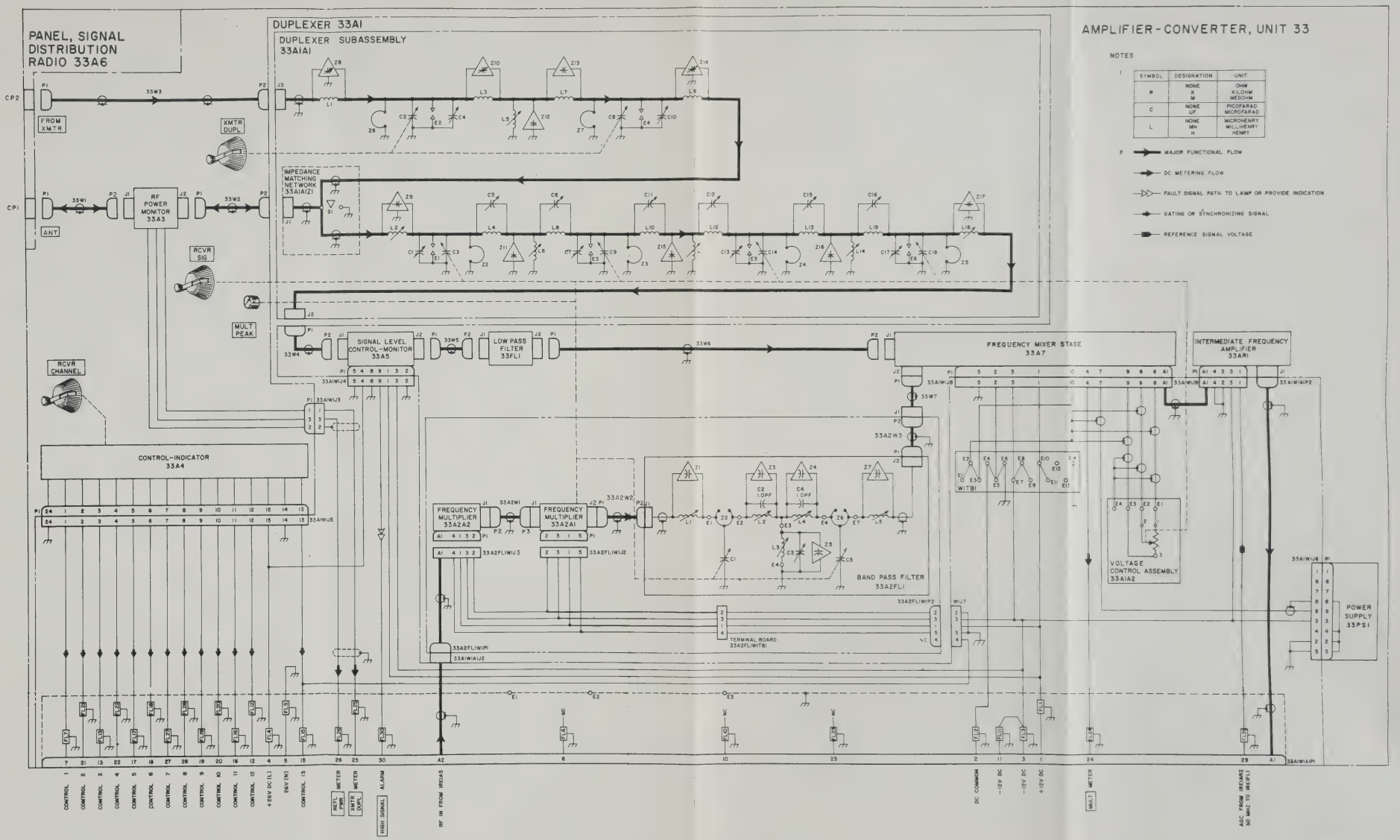
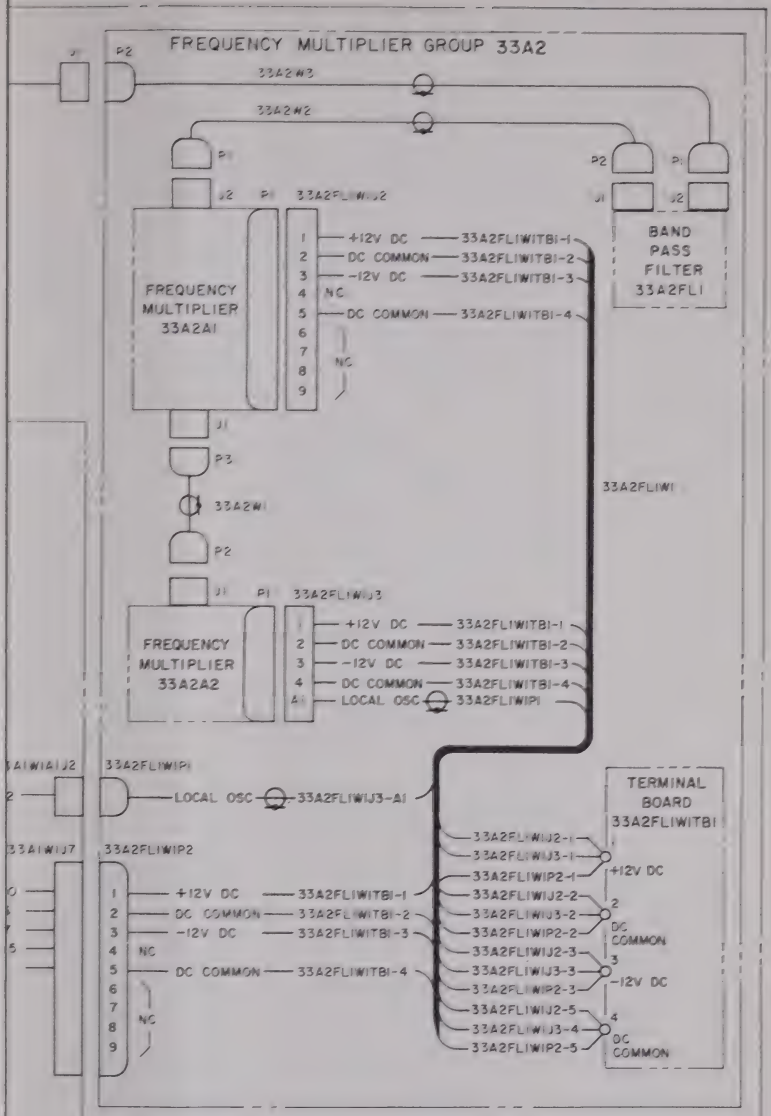


Figure 7-6. Amplifier-Converter AM-4317/GRC-103(V), band II receiver RF head, schematic diagram.



AMPLIFIER-CONVERTER UNIT 33

TM5820-540-35-750

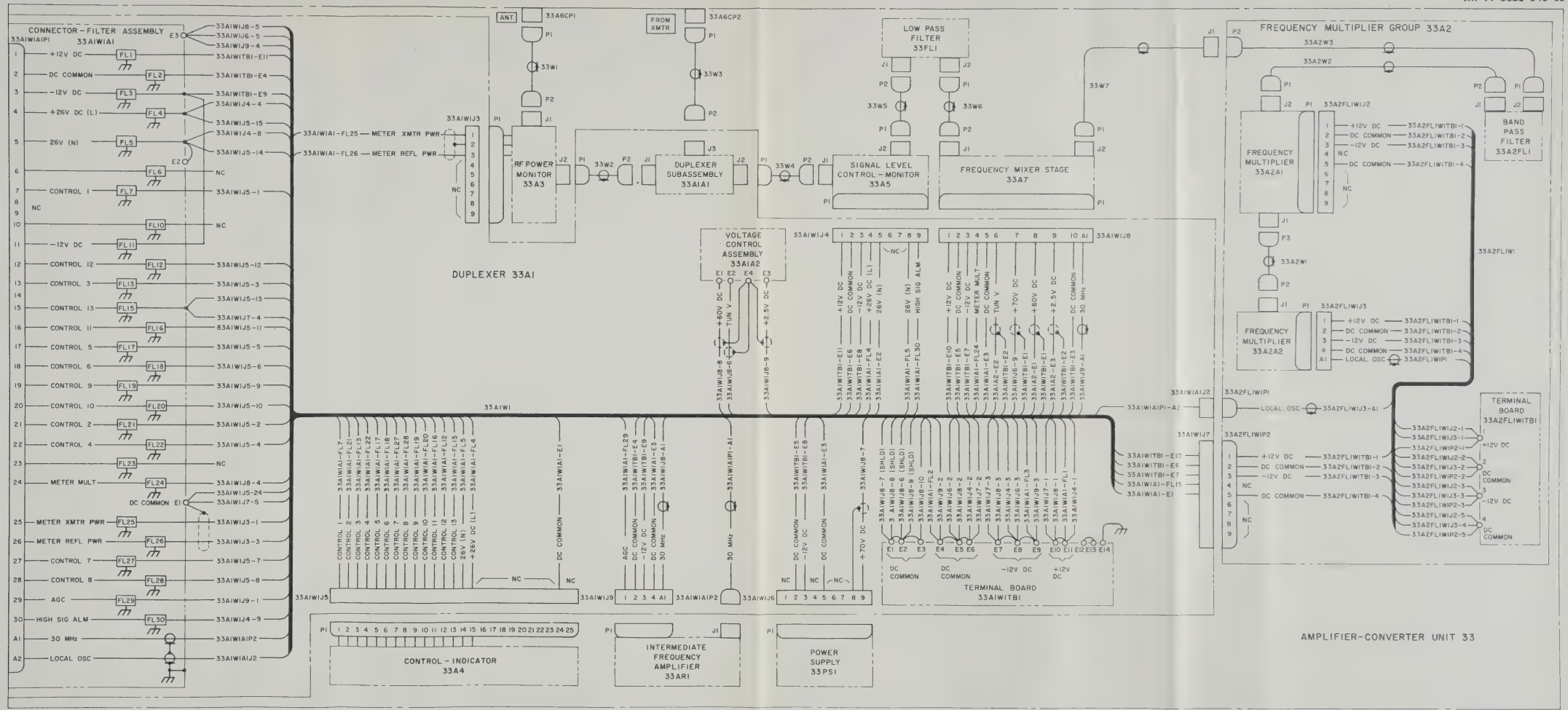
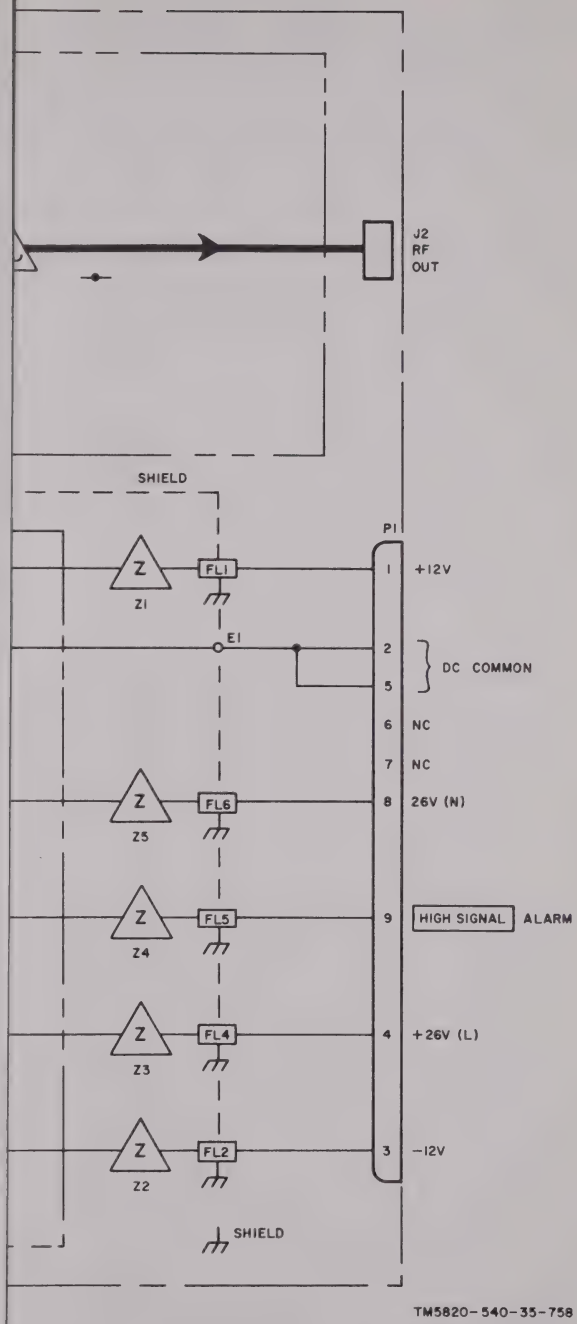


Figure 7-7. Amplifier-Converter AM-4317/GRC-103(V), band II receiver RF head, interconnecting diagram.

TM5820-540-35-750


J2
RF
OUT
SHIELD
P1
Z
Z1
FL1
1
+12V
E1
2
5
DC COMMON
6
NC
7
NC
Z5
FL6
8
26V (N)
Z4
FL5
9
HIGH SIGNAL
ALARM
Z3
FL4
4
+26V (L)
Z2
FL2
3
-12V
SHIELD
TM5820-540-35-758

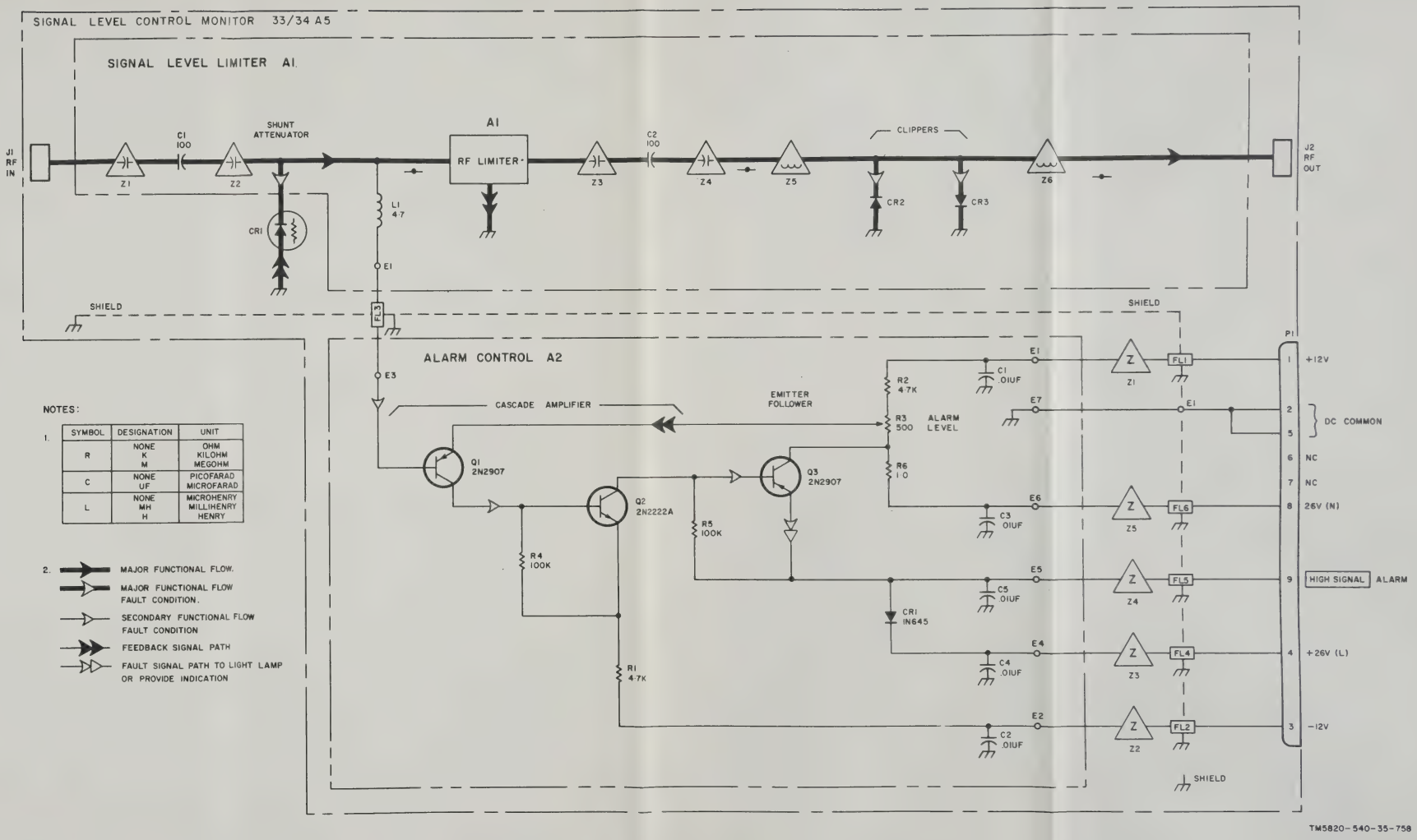
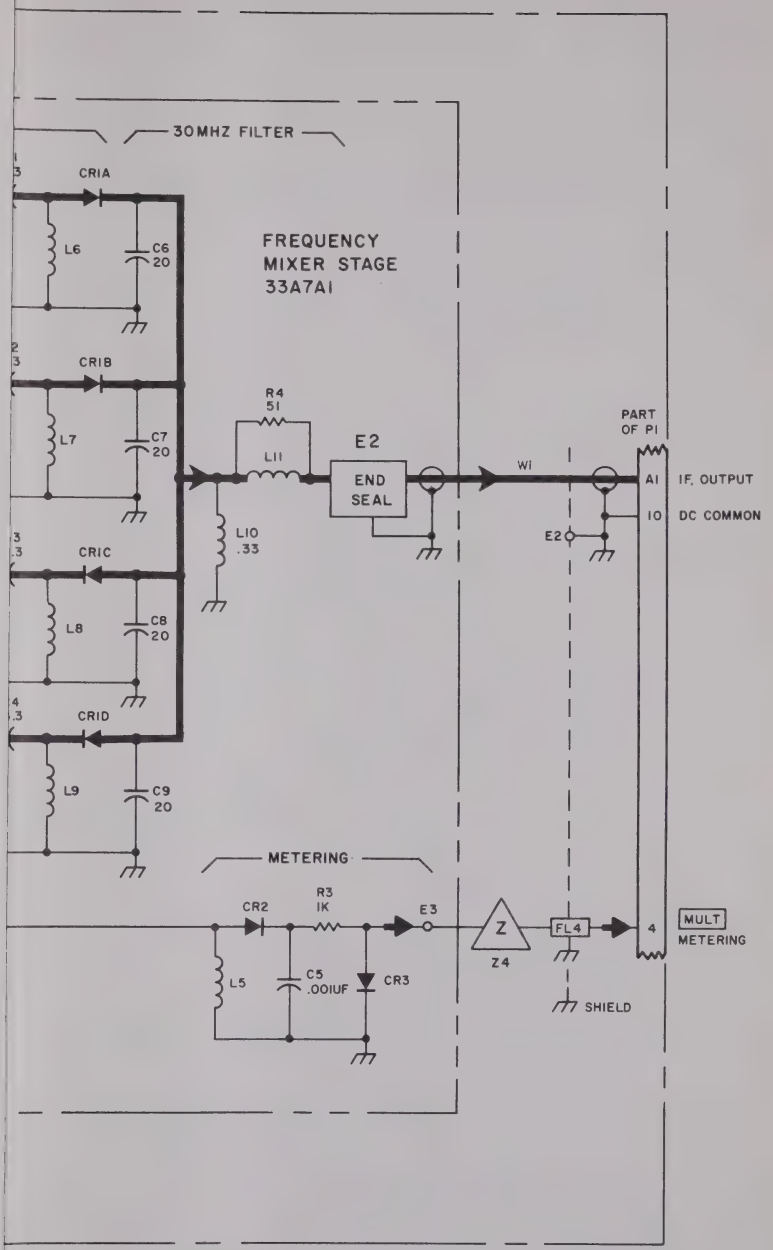


Figure 7-8. Signal level control-monitor 33A5 or 34A5, schematic diagram.



TM5820-540-35-760

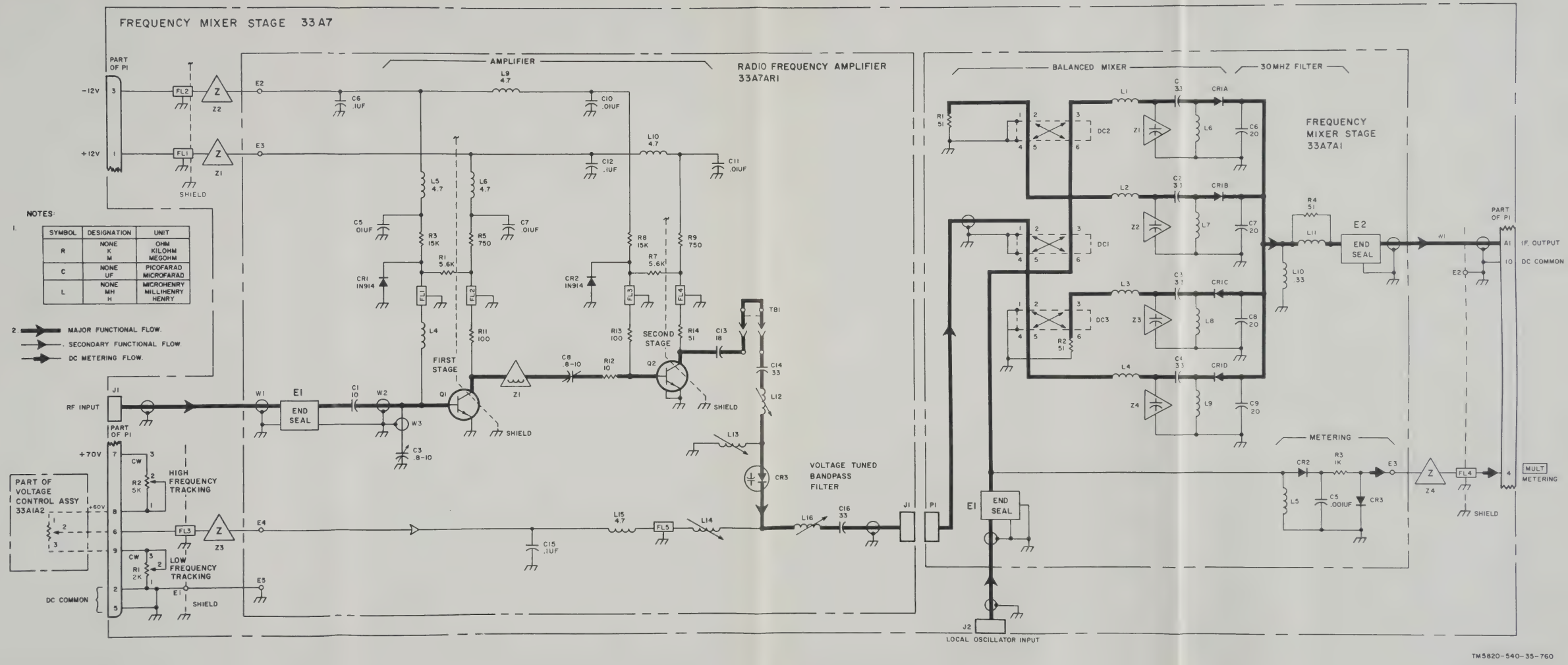
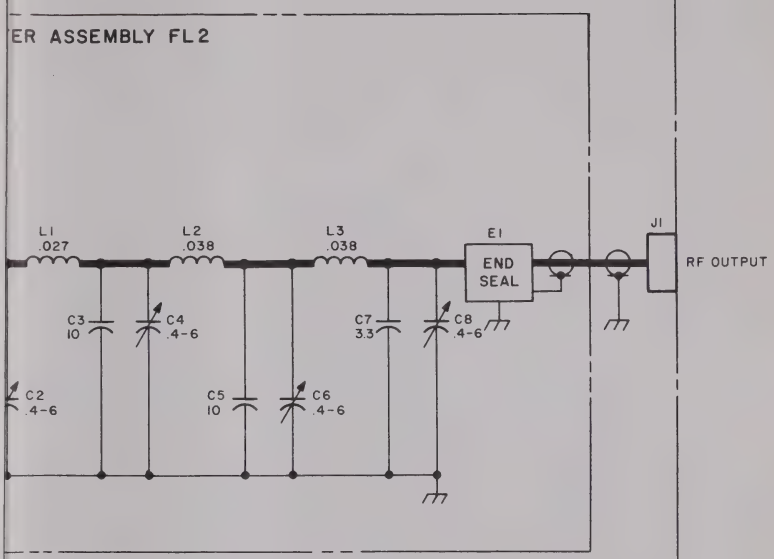


Figure 7–9. Frequency mixer stage 33A7, schematic diagram.



	DESIGNATION	UNIT
	NONE K M	OHM KILOHM MEGOHM
	NONE UF	PICOFARAD MICROFARAD
	NONE MH H	MICROHENRY MILLIHENRY HENRY

■ MAJOR FUNCTIONAL FLOW.

TM5820-540-35-765

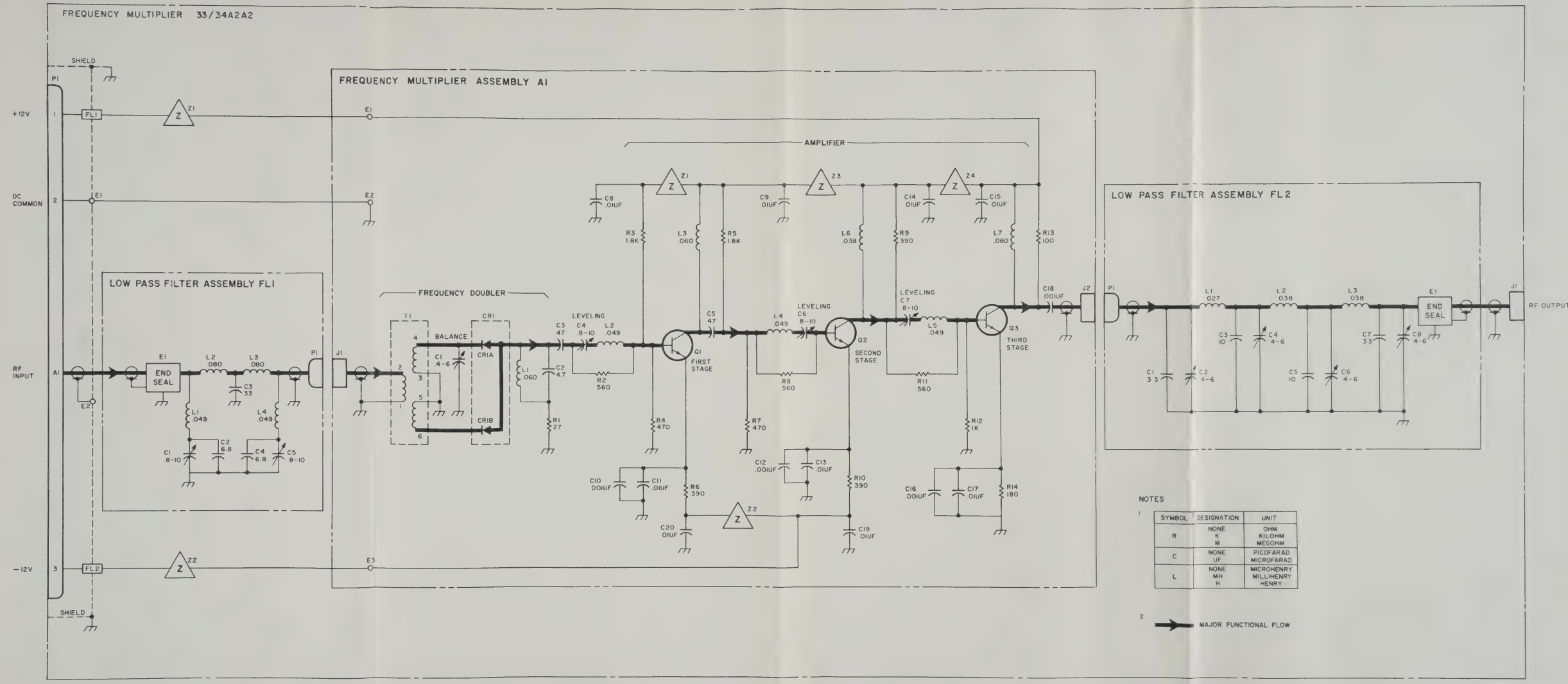
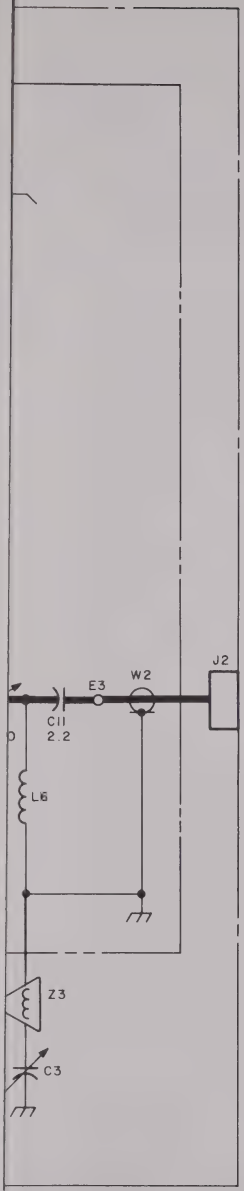


Figure 7-10. Frequency multiplier 33A2A2 or 34A2A2, schematic diagram.



NOTES:

1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

2. → MAJOR FUNCTIONAL FLOW.

TM5820-540-35-764

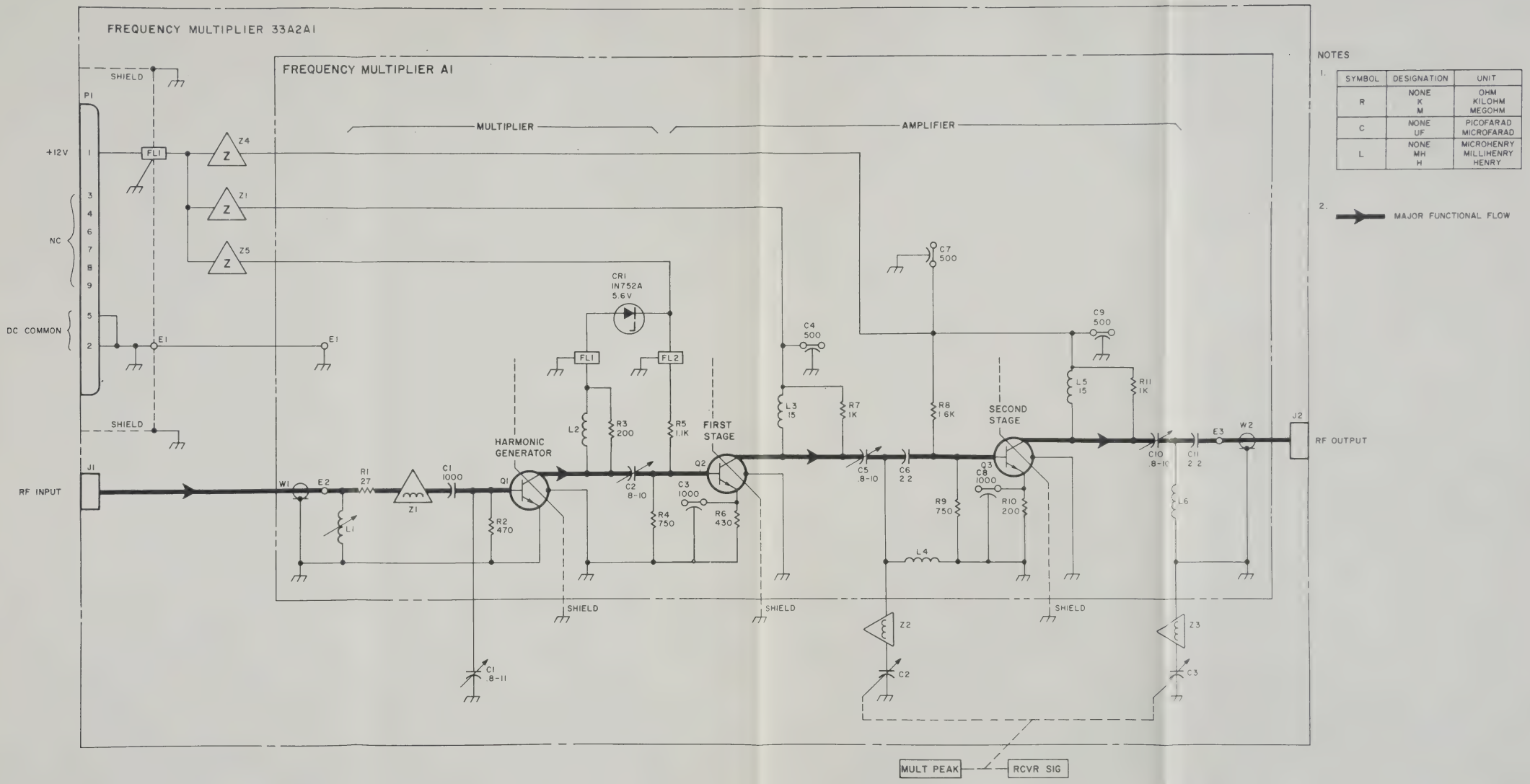
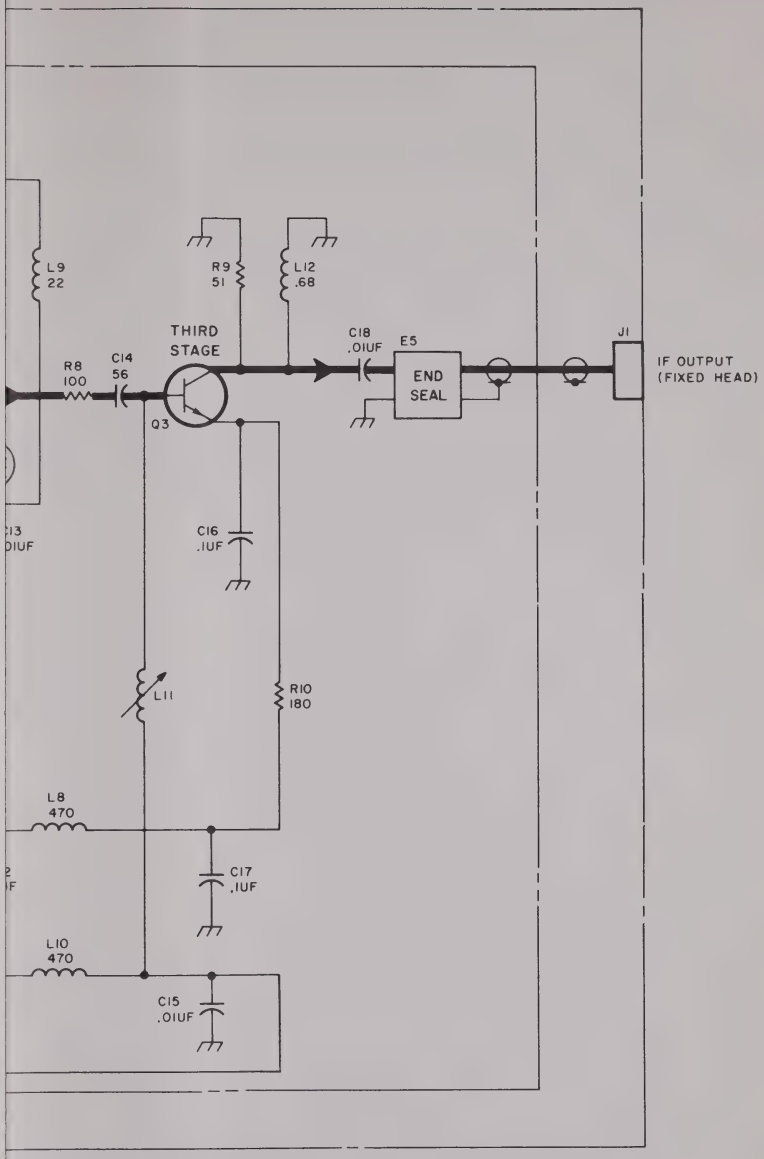
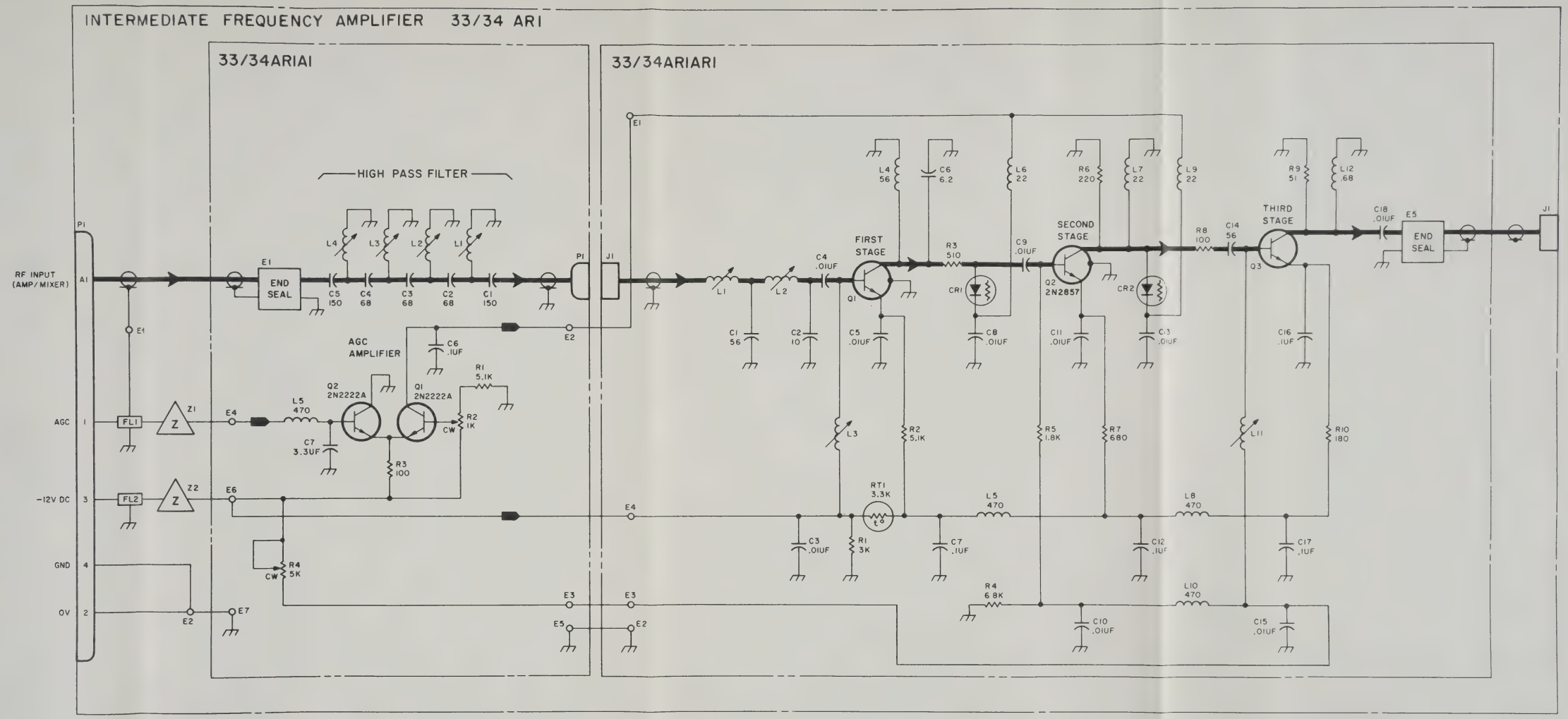


Figure 7-11. Frequency multiplier 33A2A1, schematic diagram.



TM5820-540-35-753



NOTES:

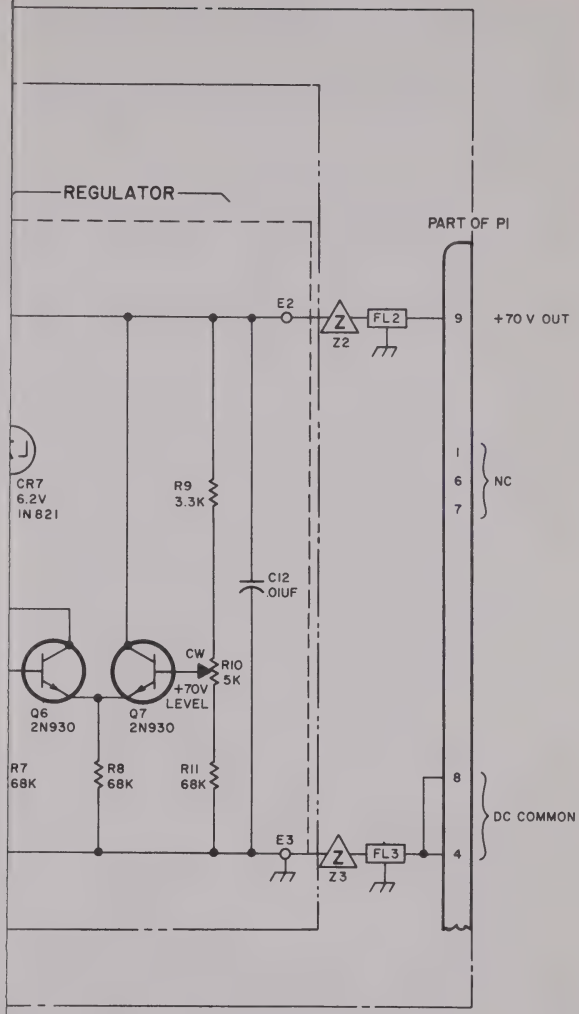
1.

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

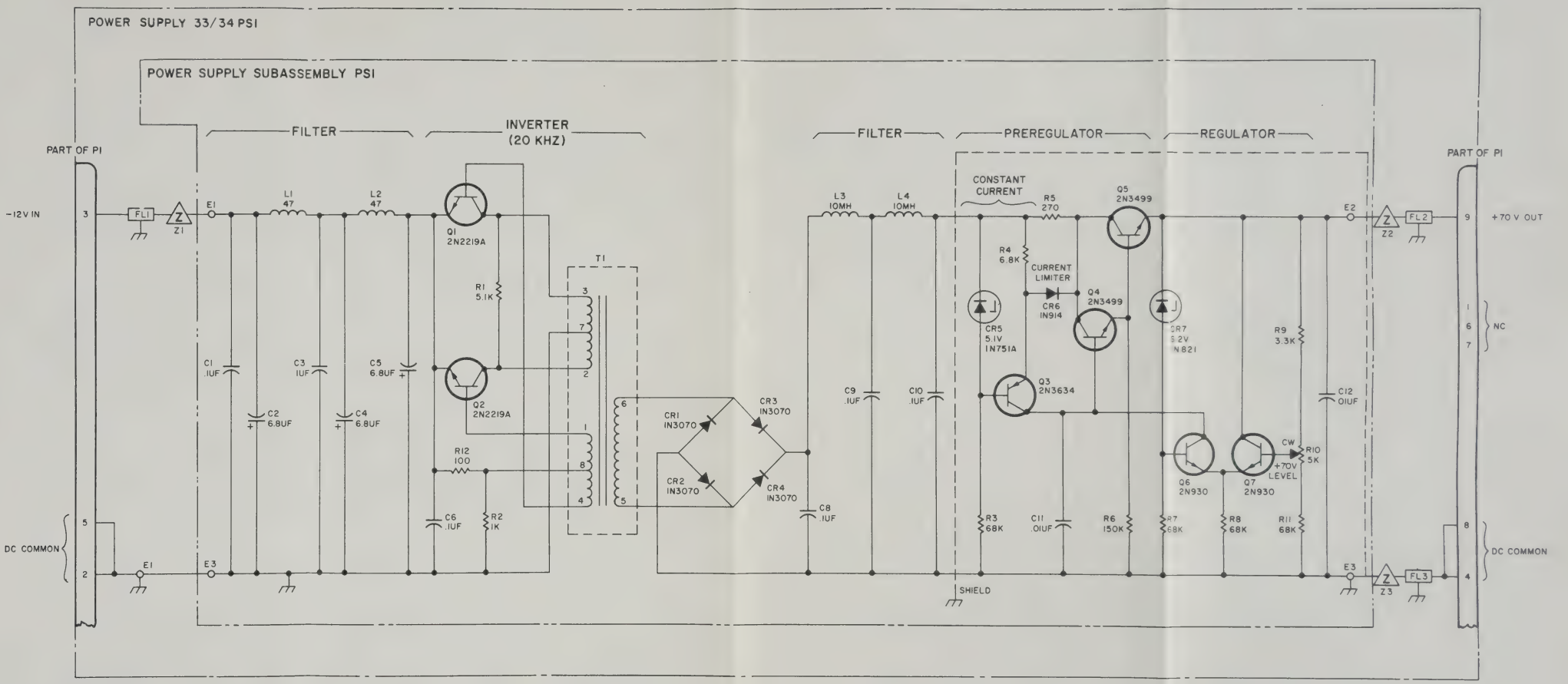
2. MAJOR FUNCTIONAL FLOW.
REFERENCE SIGNAL VOLTAGE.

Figure 7-12. Intermediate frequency amplifier 33AR1 or 34AR1, schematic diagram.

TM5820-540-35-753



TM5820-540-35-768

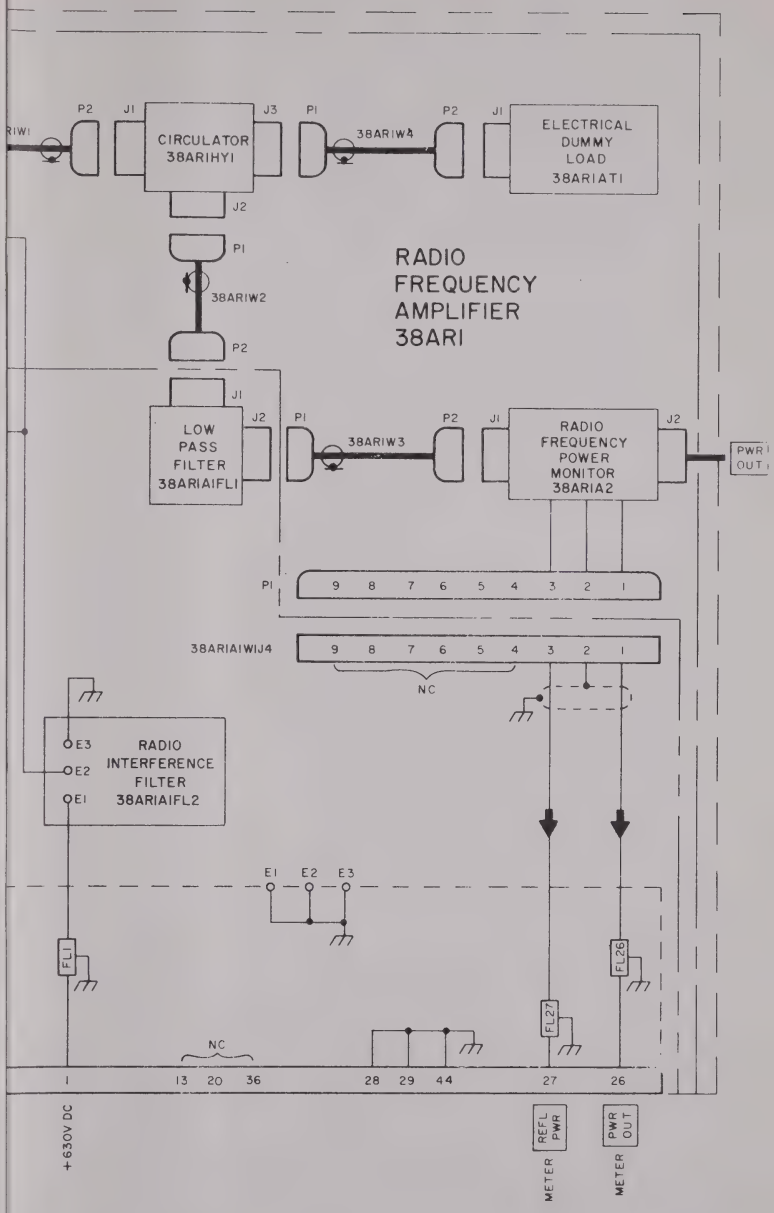


NOTE:

SYMBOL	DESIGNATION	UNIT
R	NONE K M	OHM KILOHM MEGOHM
C	NONE UF	PICOFARAD MICROFARAD
L	NONE MH H	MICROHENRY MILLIHENRY HENRY

TM5820-540-35-768

Figure 7-13. Power supply 33PS1 or 34PS1, schematic diagram.



1. Amplifier-Frequency Multiplier AM-4322/GRC-103(V), band III transmitter RF head, schematic diagram.

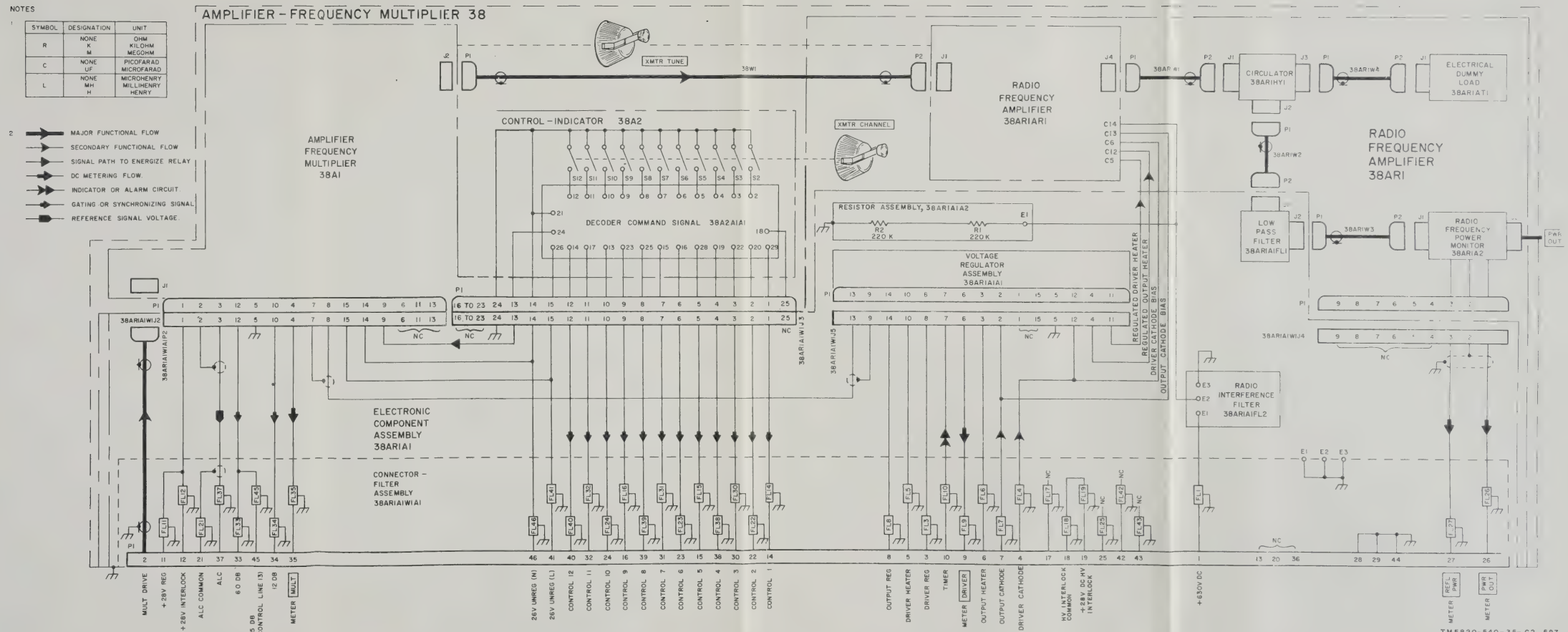
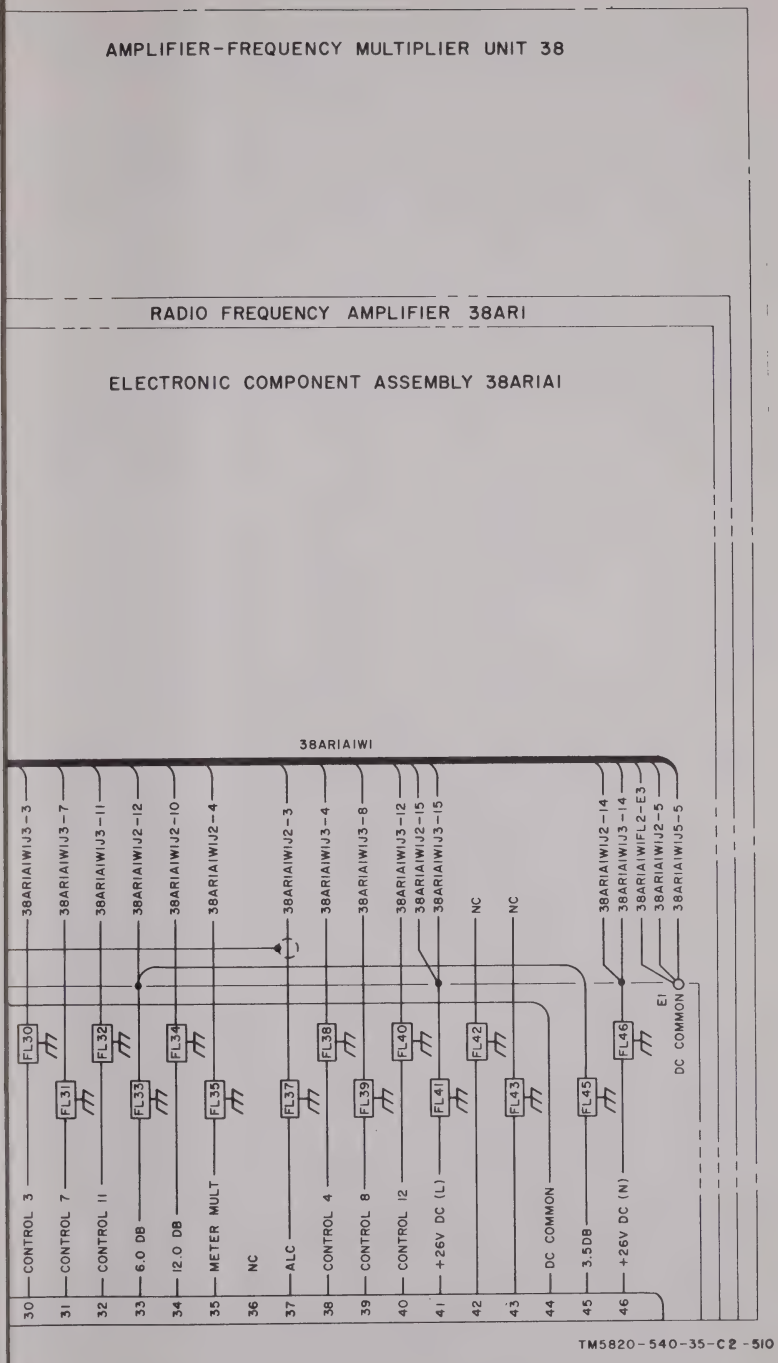


Figure 8-1. Amplifier-Frequency Multiplier AM-4322/GRC-103(V), band III transmitter RF head, schematic diagram.



2. Amplifier-Frequency Multiplier AM-4322/GRC-103(V), band III transmitter RF head, interconnecting diagram.

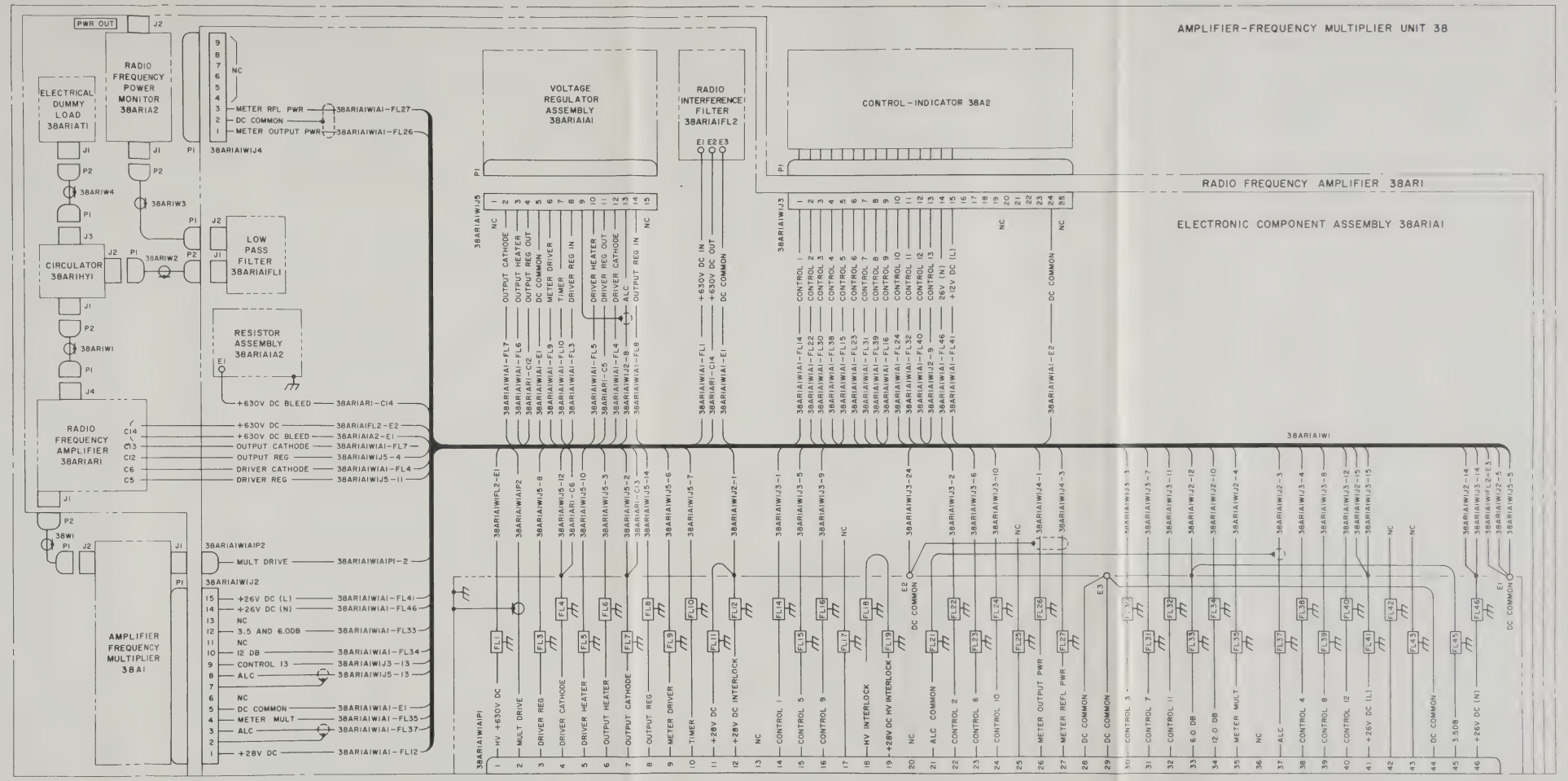
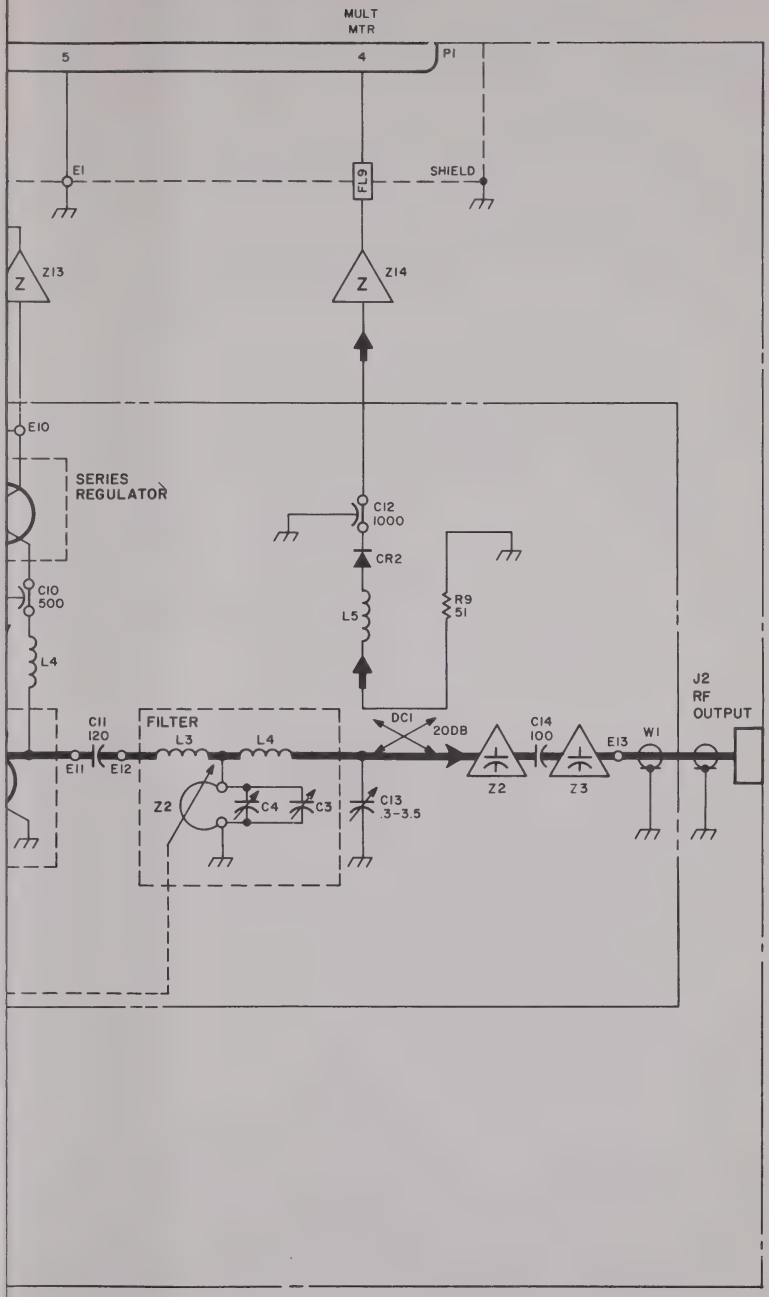


Figure 8-2. Amplifier-Frequency Multiplier AM-4322/GRC-103(V), band III transmitter RF head, interconnecting diagram.



TM5820-540-35-568

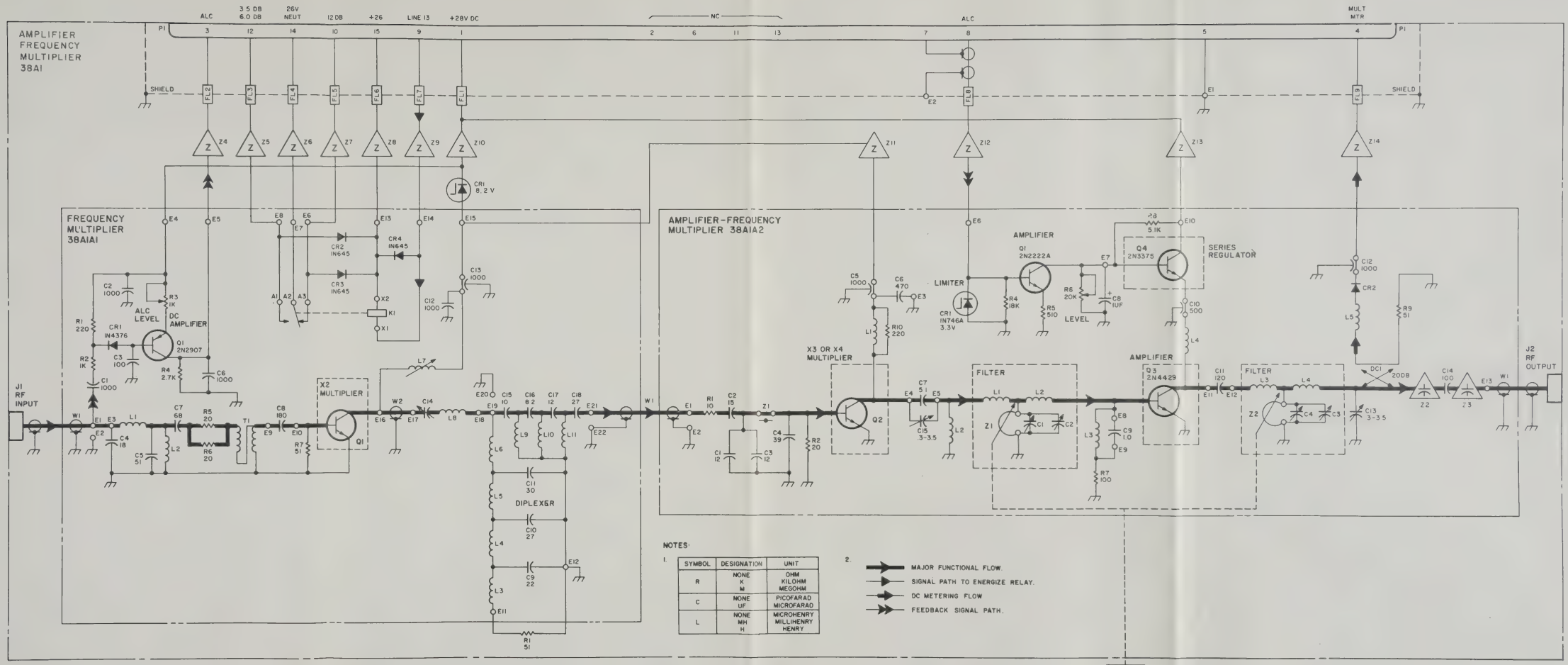


Figure 8-3. Amplifier-frequency multiplier 38A1, schematic diagram.

TM5820-540-35-568

NO CVR	CODING												
	1	2	3	4	5	6	7	8	9	10	11	12	13
99	●	●						●		●	●		●
00				●				●		●	●		●
01	●			●				●		●	●		●
02		●	●					●		●	●		●
03	●	●	●					●		●	●		●
04				●				●		●	●		●
05	●			●				●		●	●		●
06		●		●				●		●	●		●
07	●	●		●				●		●	●		●
08			●	●				●		●	●		●
09	●		●	●				●		●	●		●
10		●	●	●				●		●	●		●
11	●	●	●	●				●		●	●		●
12					●			●		●	●		●
13	●				●			●		●	●		●
14		●			●			●		●	●		●
15	●	●			●			●		●	●		●
16			●		●			●		●	●		●
17	●		●		●			●		●	●		●
18		●	●		●			●		●	●		●
19	●	●	●		●			●		●	●		●
20				●	●			●		●	●		●
21	●			●	●			●		●	●		●
22		●		●	●			●		●	●		●
23	●	●		●	●			●		●	●		●
24			●	●	●			●		●	●		●
25	●		●	●	●			●		●	●		●
26		●	●	●	●			●		●	●		●
27	●	●	●	●	●			●		●	●		●
28						●	●	●		●	●		●
29	●					●	●	●		●	●		●
30		●				●	●	●		●	●		●
31	●	●				●	●	●		●	●		●
32			●			●	●	●		●	●		●
33	●		●			●	●	●		●	●		●
34		●	●			●	●	●		●	●		●
35	●	●	●			●	●	●		●	●		●
36				●		●	●	●		●	●		●
37	●			●		●	●	●		●	●		●
38		●		●		●	●	●		●	●		●
39	●	●		●		●	●	●		●	●		●
40			●	●		●	●	●		●	●		●
41	●		●	●		●	●	●		●	●		●
42		●	●	●		●	●	●		●	●		●
43	●	●	●	●		●	●	●		●	●		●
44					●	●	●	●		●	●		●
45	●				●	●	●	●		●	●		●
46		●			●	●	●	●		●	●		●
47	●	●			●	●	●	●		●	●		●
48			●		●	●	●	●		●	●		●
49	●		●		●	●	●	●		●	●		●
50		●	●		●	●	●	●		●	●		●
51	●	●	●		●	●	●	●		●	●		●
52				●	●	●	●	●		●	●		●
53	●			●	●	●	●	●		●	●		●
54		●		●	●	●	●	●		●	●		●
55	●	●		●	●	●	●	●		●	●		●
56			●	●	●	●	●	●		●	●		●
57	●		●	●	●	●	●	●		●	●		●
58		●	●	●	●	●	●	●		●	●		●
59	●	●	●	●	●	●	●	●		●	●		●
60								●	●	●	●		●
61	●							●	●	●	●		●
62		●						●	●	●	●		●
63	●	●						●	●	●	●		●
64			●					●	●	●	●		●
65	●		●					●	●	●	●		●

CHANNEL NO		CODING												
XMTR	RCVR	1	2	3	4	5	6	7	8	9	10	11	12	13
1526	1466		●	●					●	●	●	●		●
1527	1467	●	●	●					●	●	●	●		●
1528	1468				●				●	●	●	●		●
1529	1469	●			●				●	●	●	●		●
1530	1470		●		●				●	●	●	●		●
1531	1471	●	●		●				●	●	●	●		●
1532	1472			●	●				●	●	●	●		●
1533	1473	●		●	●				●	●	●	●		●
1534	1474		●	●	●				●	●	●	●		●
1535	1475	●	●	●	●				●	●	●	●		●
1536	1476					●			●	●	●	●		●
1537	1477	●				●			●	●	●	●		●
1538	1478		●			●			●	●	●	●		●
1539	1479	●	●			●			●	●	●	●		●
1540	1480			●		●			●	●	●	●		●
1541	1481	●		●		●			●	●	●	●		●
1542	1482			●		●			●	●	●	●		●
1543	1483	●	●	●		●			●	●	●	●		●
1544	1484				●	●			●	●	●	●		●
1545	1485	●			●	●			●	●	●	●		●
1546	1486		●		●	●			●	●	●	●		●
1547	1487	●	●		●	●			●	●	●	●		●
1548	1488			●	●	●			●	●	●	●		●
1549	1489	●		●	●	●			●	●	●	●		●
1550	1490		●	●	●	●			●	●	●	●		●
1551	1491	●	●	●	●	●			●	●	●	●		●
1552	1492							●	●	●	●	●		●
1553	1493	●						●	●	●	●	●		●
1554	1494		●					●	●	●	●	●		●
1555	1495	●	●					●	●	●	●	●		●
1556	1496			●				●	●	●	●	●		●
1557	1497	●		●				●	●	●	●	●		●
1558	1498		●	●				●	●	●	●	●		●
1559	1499	●	●	●				●	●	●	●	●		●
1560	1500				●			●	●	●	●	●		●
1561	1501	●			●			●	●	●	●	●		●
1562	1502		●		●			●	●	●	●	●		●
1563	1503	●	●		●			●	●	●	●	●		●
1564	1504			●	●			●	●	●	●	●		●
1565	1505	●		●	●			●	●	●	●	●		●
1566	1506		●	●	●			●	●	●	●	●		●
1567	1507	●	●	●	●			●	●	●	●	●		●
1568	1508					●	●		●	●	●	●		●
1569	1509	●				●	●		●	●	●	●		●
1570	1510		●			●	●		●	●	●	●		●
1571	1511	●	●			●	●		●	●	●	●		●
1572	1512			●		●	●		●	●	●	●		●
1573	1513	●		●		●	●		●	●	●	●		●
1574	1514		●	●		●	●		●	●	●	●		●
1575	1515	●	●	●		●	●		●	●	●	●		●
1576	1516				●	●	●		●	●	●	●		●
1577	1517	●			●	●	●		●	●	●	●		●
1578	1518		●		●	●	●		●	●	●	●		●
1579	1519	●	●		●	●	●		●	●	●	●		●
1580	1520			●	●	●	●		●	●	●	●		●
1581	1521	●		●	●	●	●		●	●	●	●		●
1582	1522		●	●	●	●	●		●	●	●	●		●
1583	1523	●	●	●	●	●	●		●	●	●	●		●
1584	1524							●	●	●	●	●		●
1585	1525	●						●	●	●	●	●		●
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1587	1527	●	●					●	●	●	●	●		●
1588	1528			●				●	●	●	●	●		●
1589	1529	●		●				●	●	●	●	●		●
1590	1530		●	●				●	●	●	●	●		●
1591	1531	●	●	●				●	●	●	●	●		●
1592	1532				●			●	●	●	●	●		●

CHANNEL NO		CODING												
XMTR	RCVR	1	2	3	4	5	6	7	8	9	10	11	12	13
1593	1533	●			●				●	●	●	●		●
1594	1534		●		●				●	●	●	●		●
1595	1535	●	●		●				●	●	●	●		●
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1598	1538		●	●	●				●	●	●	●		●
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	1541	●				●			●	●	●	●		●
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	1543	●	●			●			●	●	●	●		●
	1544			●		●			●	●	●	●		●
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	1547	●	●	●		●			●	●	●	●		●
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	1566		●		●		●		●	●	●	●		●
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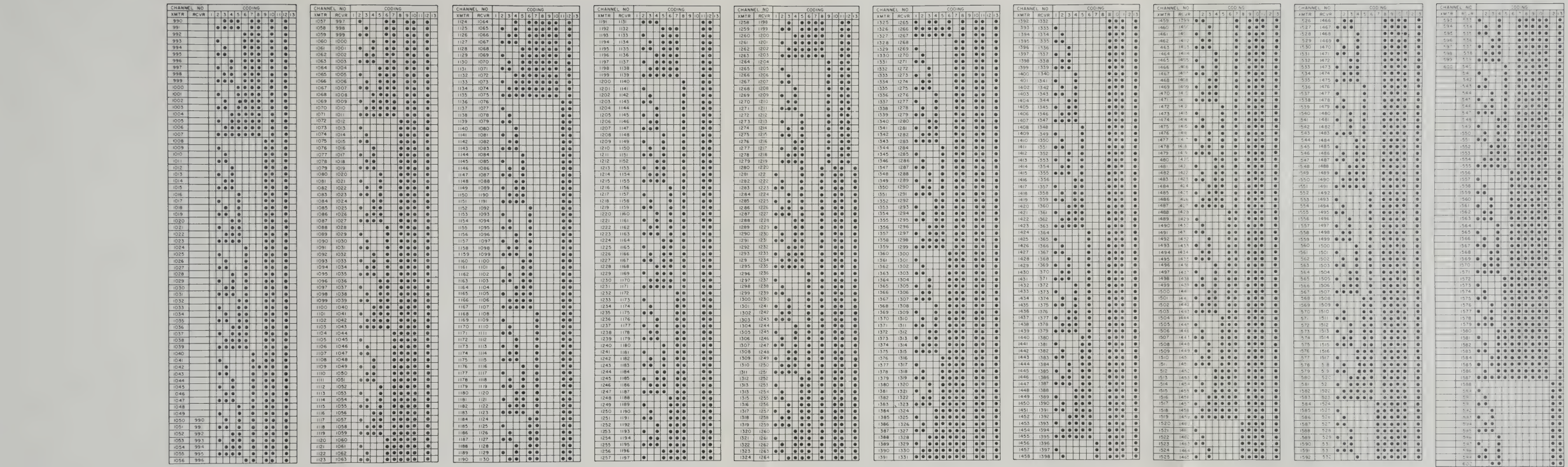
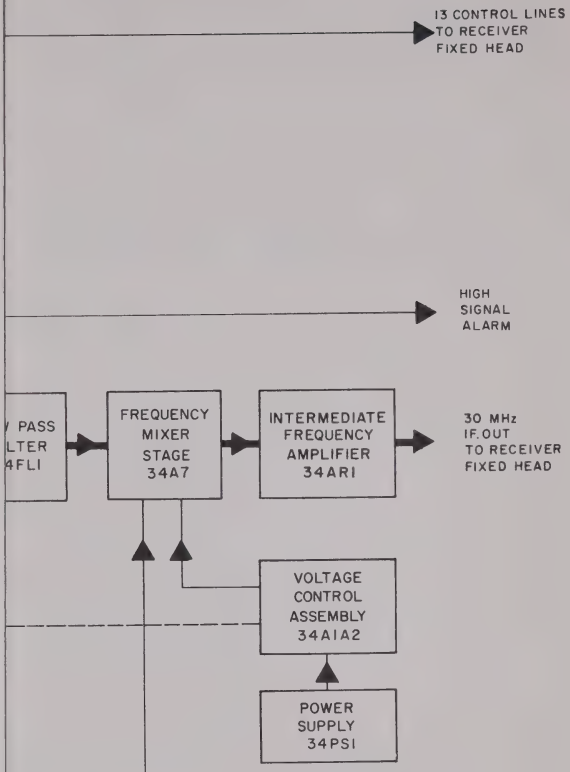


Figure 8-4. Control-indicators 38A2 and 34A4, coding tables.



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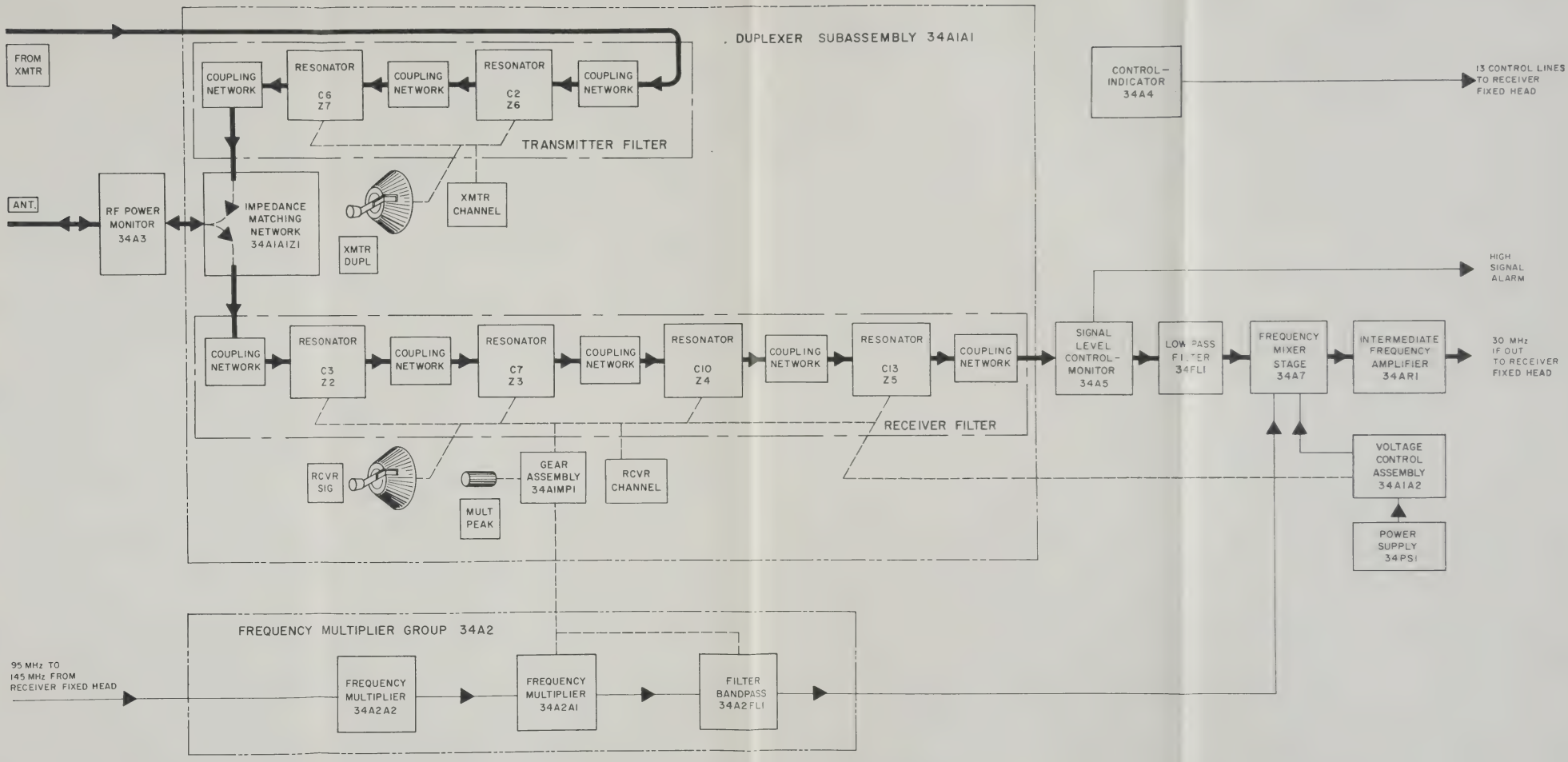
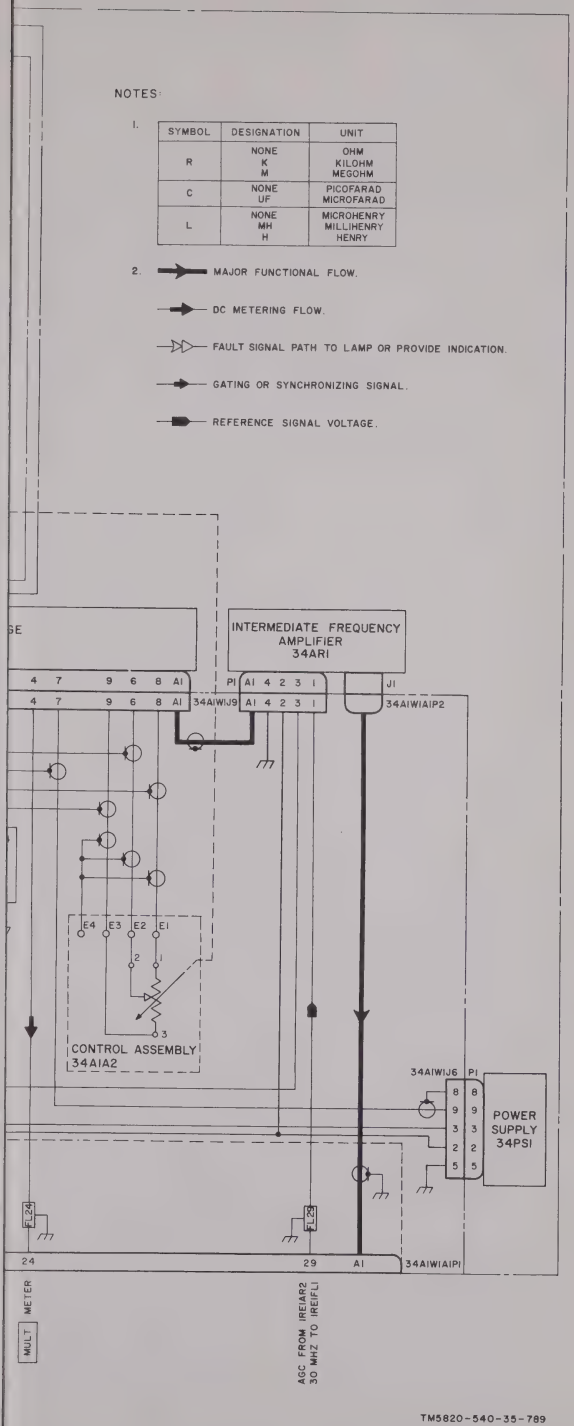


Figure 8-5. Amplifier-Converter AM-4318/GRC-103(V) band III receiver RF head, block diagram.



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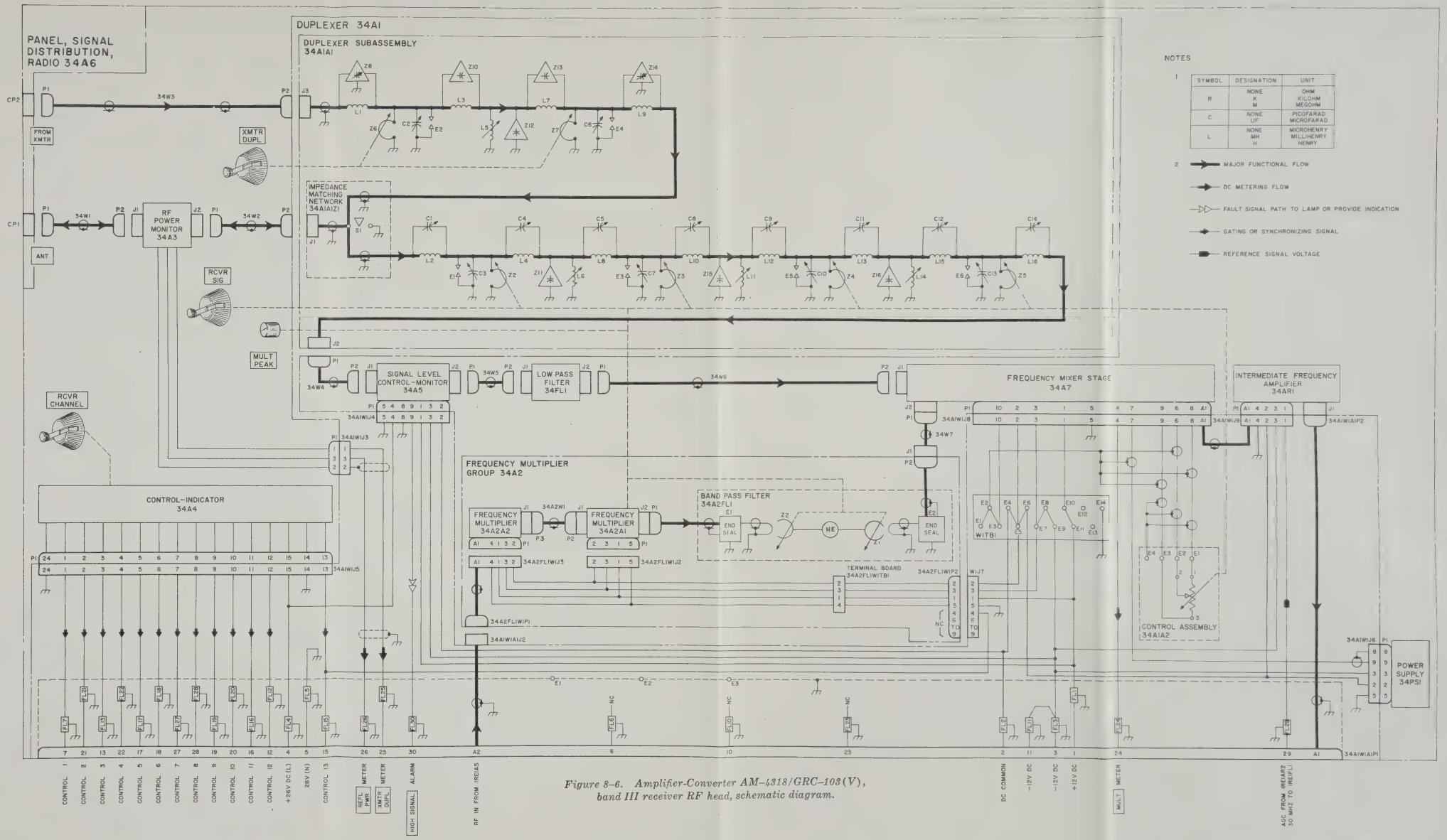
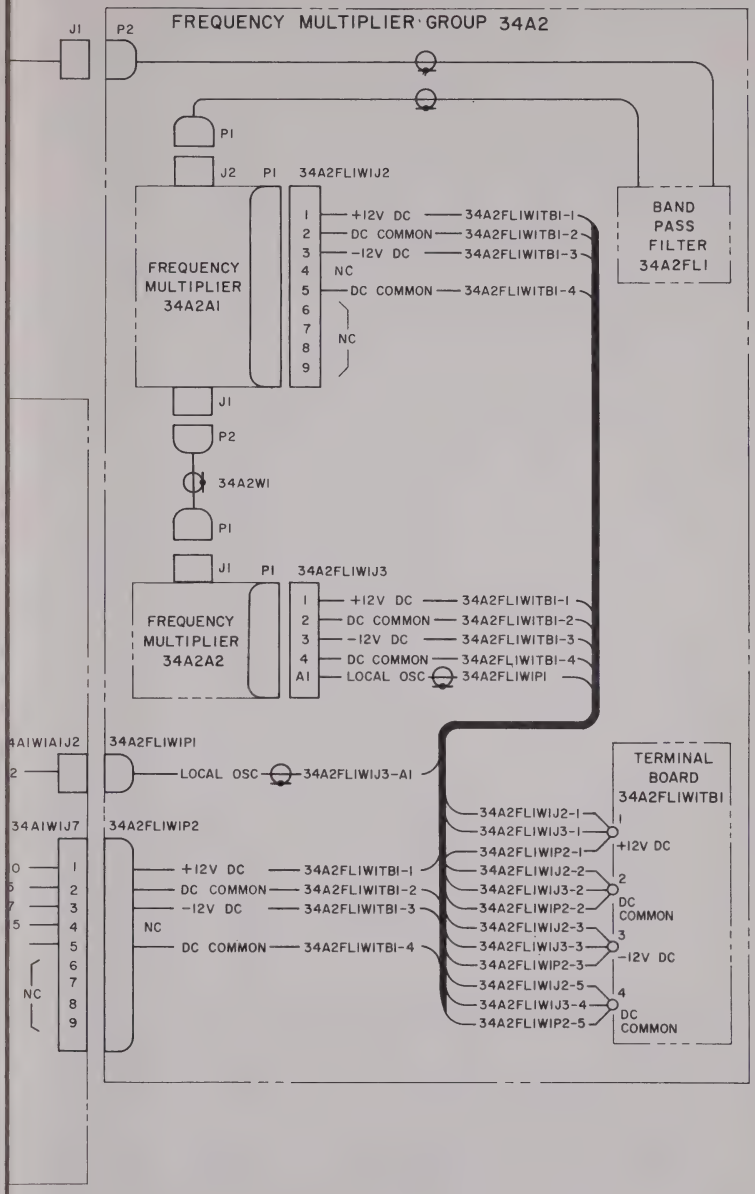


Figure 8-6. Amplifier-Converter AM-4318/GRC-103(V), band III receiver RF head, schematic diagram.

TM5820-540-35-789



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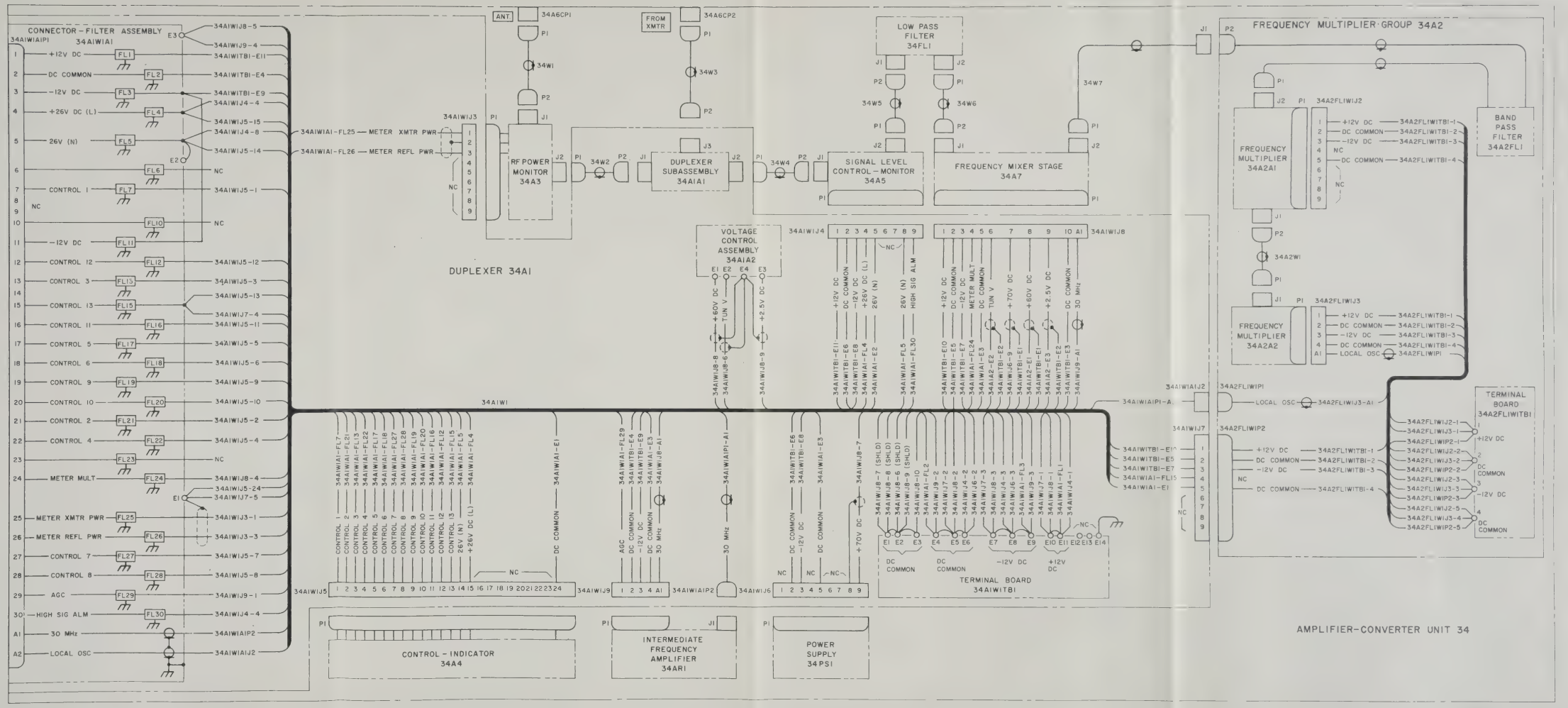

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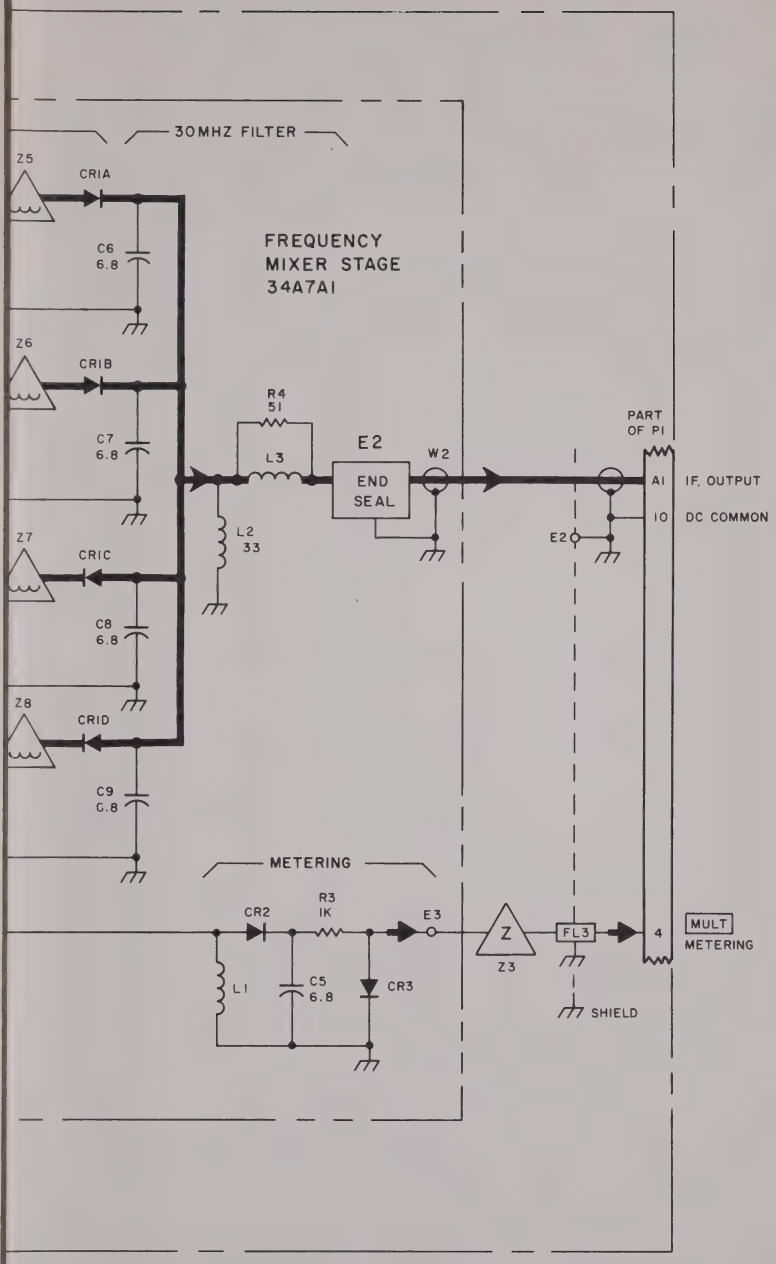
Figure 8-7. Amplifier-Converter AM-4318/GRC-103(V), band III receiver RF head, interconnecting diagram.



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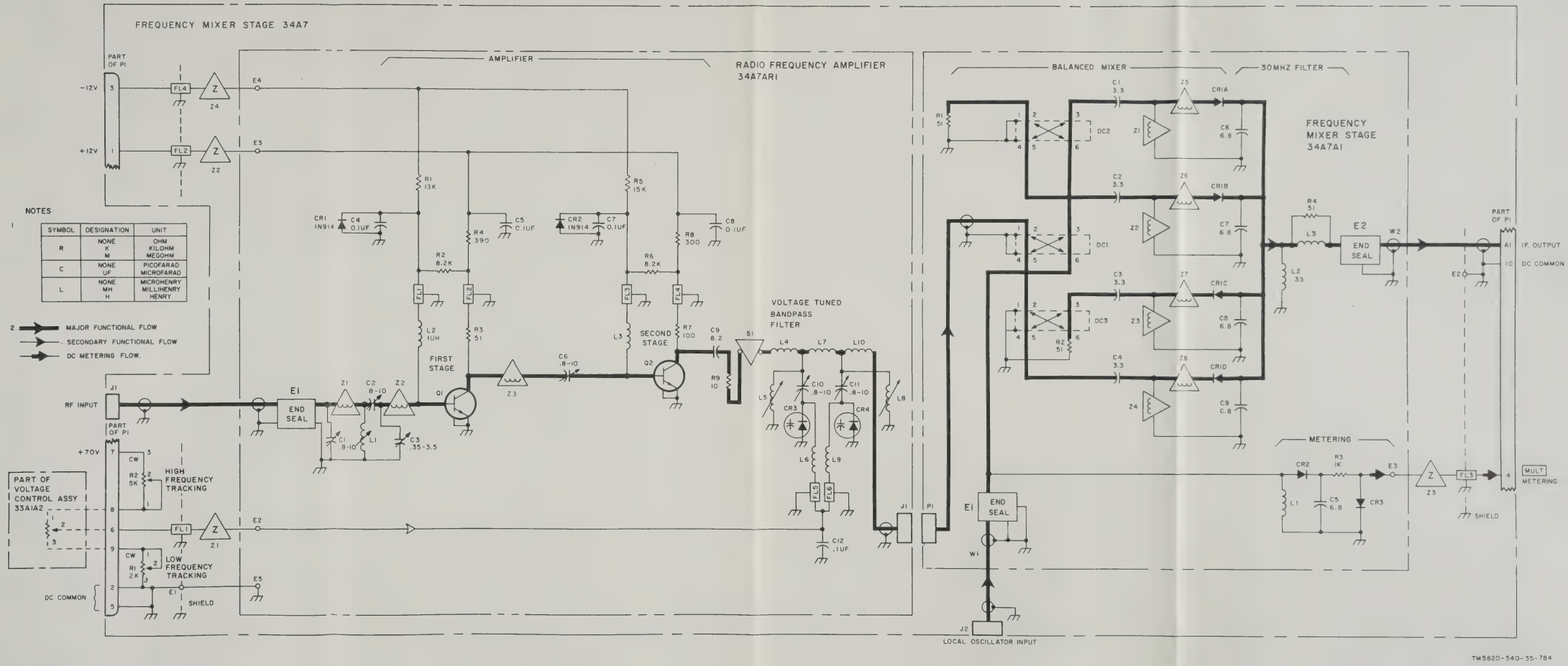
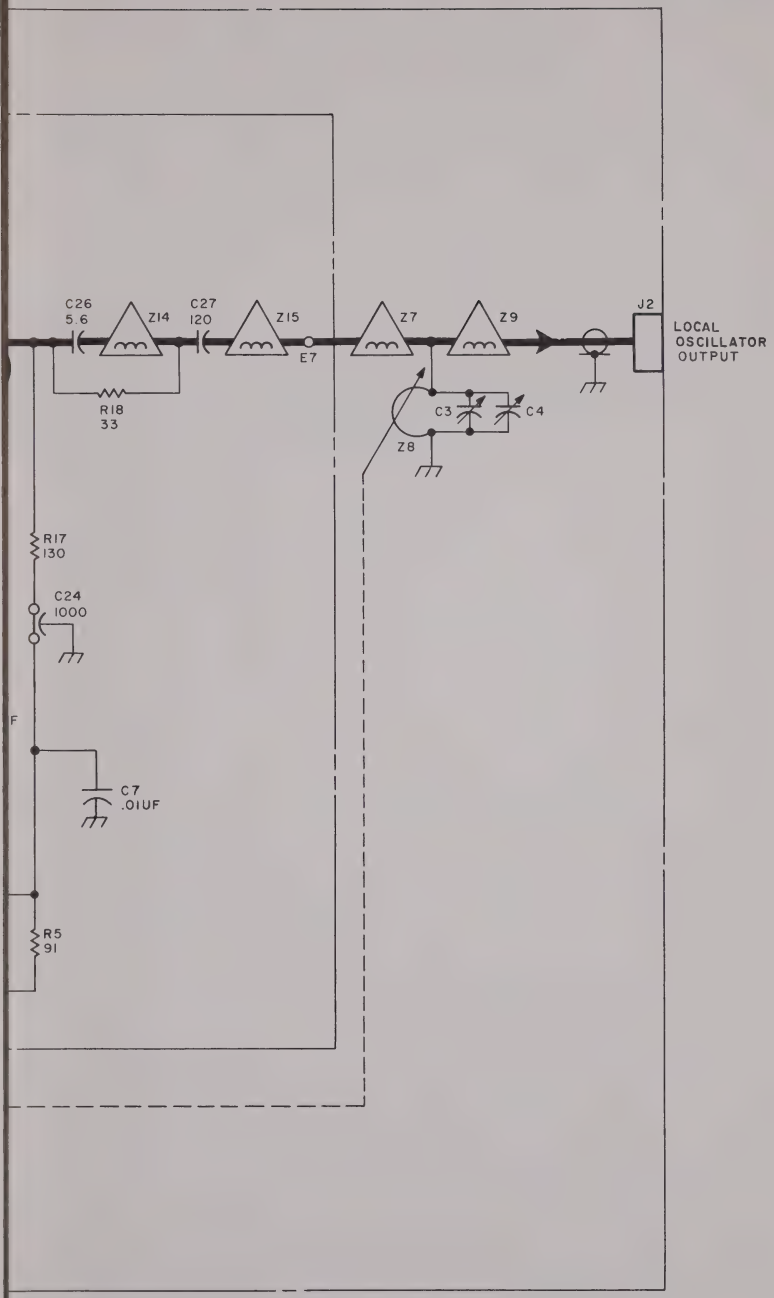


Figure 8-8. Frequency mixer stage 34A7, schematic diagram.



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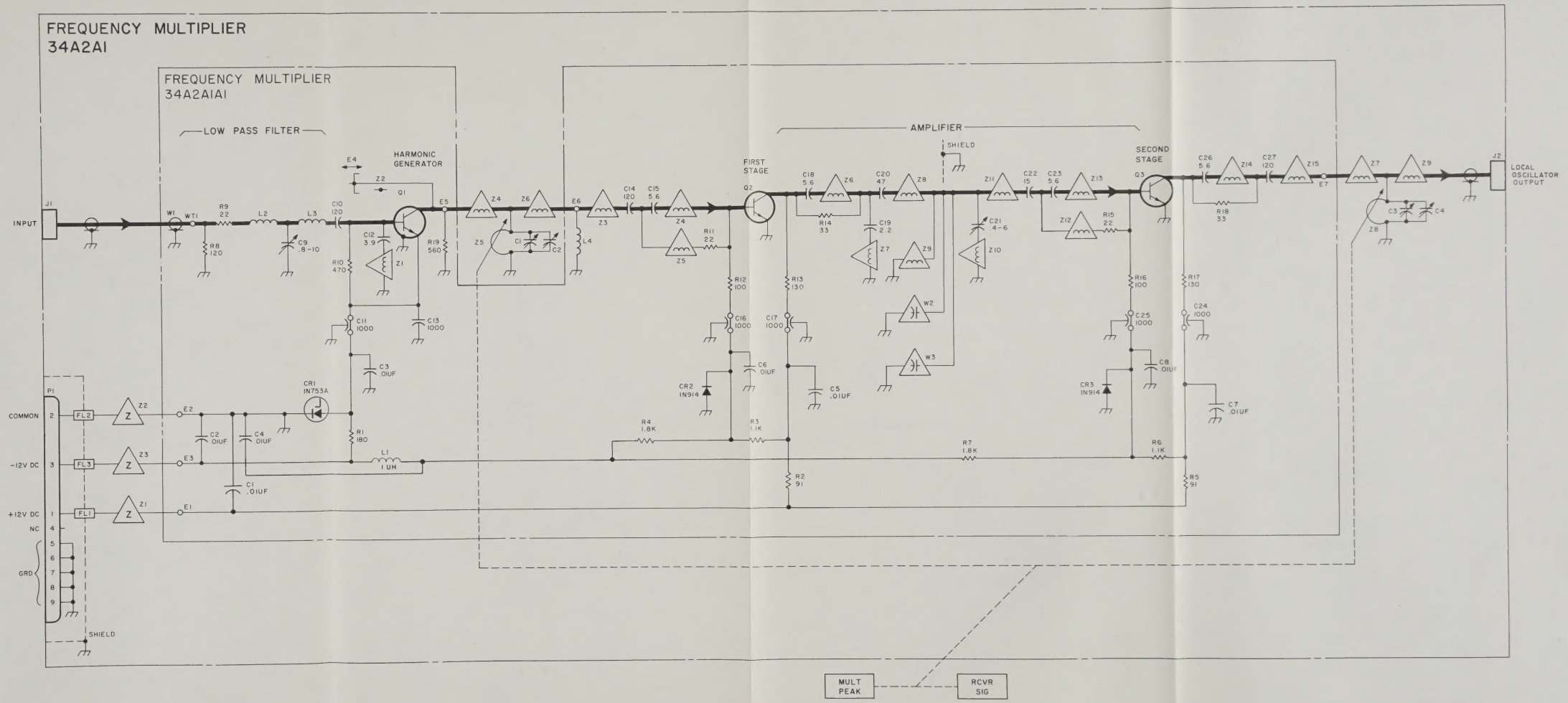
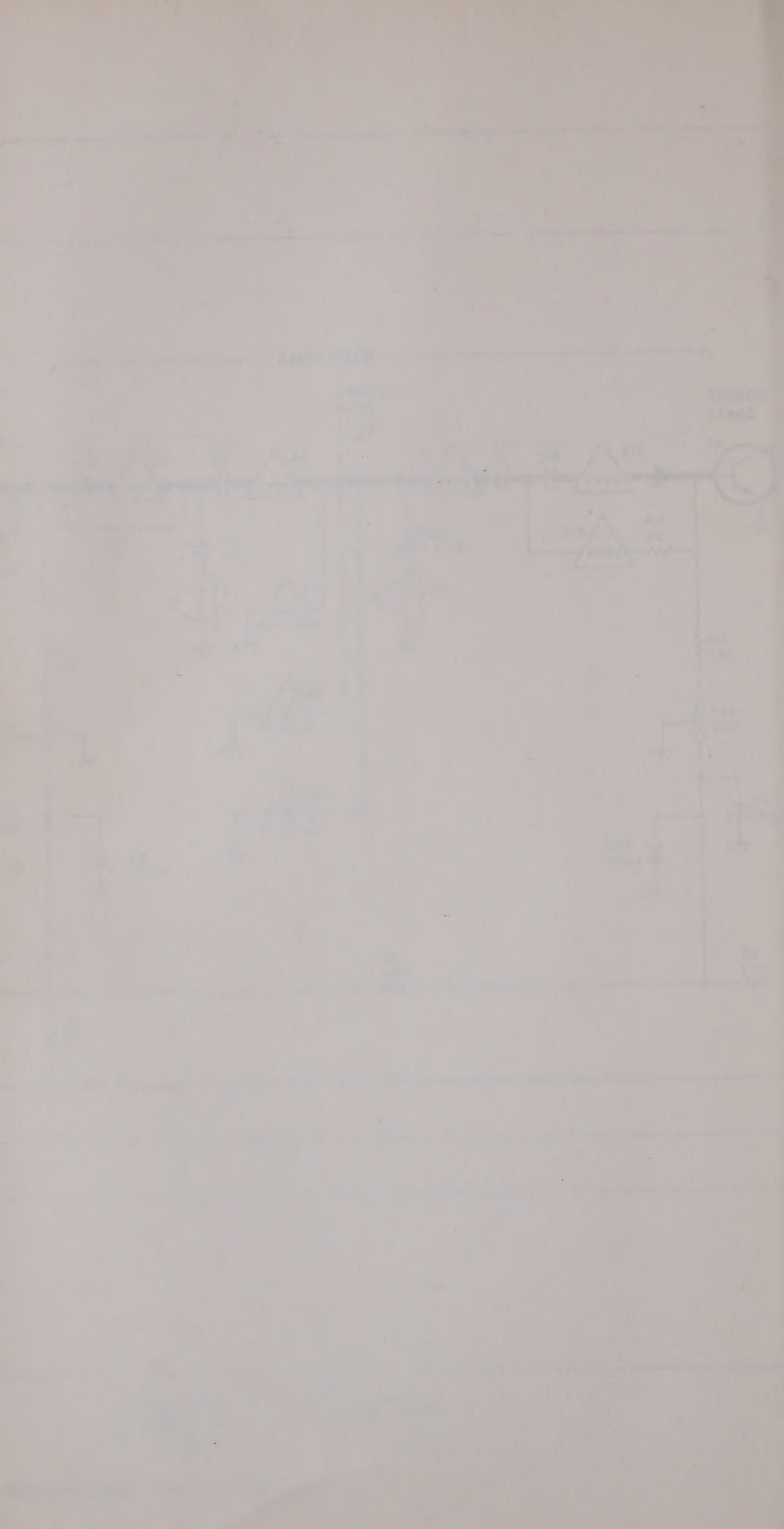
Figure 8-9. Frequency multiplier 34A2A1, schematic diagram.